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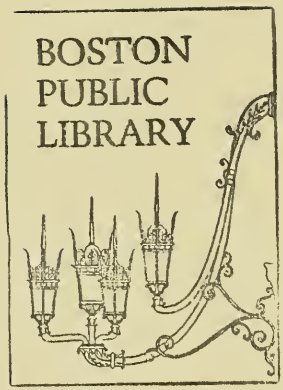
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PRUDENTIAL CENTER REDEVELOPMENT

DRAFT PROJECT AND ENVIRONMENTAL IMPACT REPORT
Volume VI: Infrastructure Systems

VI

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The Prudential Property Company, Inc.
for The Prudential Insurance Company of America

PRUDENTIAL CENTER REDEVELOPMENT

DRAFT PROJECT AND ENVIRONMENTAL IMPACT REPORT
Volume VI: Infrastructure Systems

VI

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April 12 1989

submitted to:
The Boston Redevelopment Authority
Massachusetts Executive Office of Environmental Affairs
Executive Office of Environmental Affairs Number: 7208

submitted by:
The Prudential Property Company, Inc.
for The Prudential Insurance Company of America

HMM Associates
Parsons, Brinckerhoff, Quade & Douglas, Inc.

DRAFT PROJECT AND ENVIRONMENTAL IMPACT REPORT

PROJECT

Prudential Center Redevelopment
Boston, Massachusetts

DEVELOPER

The Prudential Property Company, Inc., for The Prudential Insurance Company of America

STATUS OF PROJECT

The developer submitted a Project Notification Form to the Boston Redevelopment Authority (BRA) and an Environmental Notification Form to the Massachusetts Executive Office of Environmental Affairs (EOEA) on June 29, 1988. Scoping letters were issued to the developer by the BRA and EOEA on September 1, 1988. The EOEA number is 7208. The project is in pre-schematic design stage. Master plan approval is being sought.

BRIEF DESCRIPTION OF THE PROJECT

The project includes the addition of new offices, retail spaces and housing to the current Prudential Center site. New housing and offices, with retail uses at their base, will be constructed principally along the Boylston Street, Huntington Avenue and Belvidere Street frontages. The current retail area will be reconstructed and expanded with indoor pedestrian passageways. Enclosed pedestrian routes will provide connections between Boylston Street and Huntington Avenue, and between Copley Place and the south entrance of the Hynes Convention Center. A system of public squares, a wintergarden and outdoor open spaces will be created as amenities for those using the center and adjacent neighbors. A neighborhood commercial area, including an expanded supermarket, is proposed for Huntington Avenue and East Ring Road. East Ring Road will be improved to facilitate pedestrian flows to the shopping area. The existing parking garages will remain approximately the same size, but their capacity will be expanded by approximately 800 spaces through changes to their management.

ALTERNATIVES CONSIDERED

Two basic planning approaches have been considered for the site, and for each three scales of building program have been analyzed. Alternative A proposes two new office structures along Huntington and principally housing, with a small office structure, along Boylston. Alternative A2 has housing as well as offices along Huntington Avenue and housing, along with expanded offices, along Boylston Street. The form of structures, their heights, and the organization of pedestrian routes also vary between these two basic alternatives. Alternatives B and B2 are similar in configuration, respectively, to Alternatives A and A2, but the overall development totals 10 percent less area. Alternatives C and C2 follow the same outlines, but are 20 percent smaller in area than Alternatives A and A2. In the course of preparing these plans, a large number of other design and functional alternatives were considered and rejected as less desirable.

DEVELOPMENT PROGRAM

The three basic levels of program studied are, as follows:
(000 FAR gross sq. ft.)

Use	Alternatives A and A2	Alternatives B and B2	Alternatives C and C2
Offices	1,009	865	811
Residential	404	378	324
Retail	268*	210*	160*
Total Areas	**1,681**	**1,448**	**1,295**
Plus Indoor Pedestrian Areas	153**	153**	103**
TOTAL PROGRAM	**1,834**	**1,601**	**1,398**

* In addition, 143,000 gross sq. ft. of existing retail is demolished and rebuilt.

** Areas vary slightly between alternatives.

DEVELOPMENT SCHEDULE

The project is planned as a number of separate phases to be completed over a 10 year period. Construction will begin on the south side of the site, moving to the north. Phases along Huntington Avenue should be completed by 1994, with the Boylston Street area completed by 1999.

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IA: Summary Appendix
II: Urban Design Alternatives
III: Transportation Access Plan
IIIA: Transportation Access Plan Appendix
IV: Environmental Impacts
V: Wind Impacts
VA: Wind Impacts Appendix
VI: Infrastructure Systems
VII: Housing Impacts
VIII: Public Benefits
D: Drawing Set

PRUDENTIAL CENTER REDEVELOPMENT
VOLUME VI: INFRASTRUCTURE SYSTEMS REPORT

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1.0 INTRODUCTION

The Prudential Property Company, Inc. is planning to redevelop major portions of the Prudential Center. The program includes new housing, office, and retail space. The planned project is expected to span 9 years and be segmented into multiple construction phases. Because the proposed redevelopment has the potential to affect various local infrastructure systems, this report was prepared to address the infrastructure impact issues and mitigation alternatives.

The infrastructure impact analysis for the proposed redevelopment is primarily based on the utility demands of the existing Prudential Center and the projection of this information for estimating the utility needs of the proposed development. This approach was taken because of the magnitude of the existing development and the size of the proposed new development. Information pertaining to the existing Center provides an understanding of the current demands placed on the infrastructure systems and thus provides an excellent guide for determining the impact of the new development.

This report addresses the impacts of the redevelopment on the following infrastructure systems:

- Water Distribution
- Wastewater Disposal
- Storm Drainage
- Electric Service
- Steam Service
- Natural Gas Service
- Telecommunications

Impacts on other system facilities, during construction, can be found in the Environment Impact Report, Volume IV of the Draft Project Impact Report/Environmental Impact Report.

Information used for this study includes meter readings and billing information made available by the various utility companies and Prudential Center tenants. Where metered information was unavailable or of questionable accuracy, estimates were developed based on extrapolation from available metered information or standard estimating procedures. All results of calculations which estimate existing and new levels of use are for full

occupancy conditions. Information was also obtained from the developer and the R.M. Bradley Company (property management) regarding the various conservation methods applied over the last 15 years to reduce water and energy use.

The report describes the existing systems and their capacity to serve the proposed redevelopment. Current use levels for each infrastructure element are presented and estimates were made for the expected increased demands associated with each space use category of the new development. For each infrastructure element, the impact of these increased demands on each system is discussed and service connection information is provided. Proposed infrastructure system improvements and proposed mitigation methods to moderate the impact of the redevelopment are also presented.

The impact analysis contained in this report is based on the redevelopment Alternative A which is one of six development options under consideration by the Prudential Property Company. Alternative A was chosen for the impact evaluation because it is the most extensive and as a result has the greatest impact on the infrastructure systems. In this report, the relative impact of all other alternatives is evaluated by quantitative comparison with Alternative A.

This evaluation of development options found that alternatives A2, B, B2, C and C2 do not significantly impact the general conclusions presented for the infrastructure systems evaluated in this report. The effect of selecting a different alternative would have its greatest impact on the sizing of individual service connections while the change in scope of impacts to distribution systems would be minimal.

2.0 WATER DISTRIBUTION SYSTEM

2.1 Description of Existing Facilities

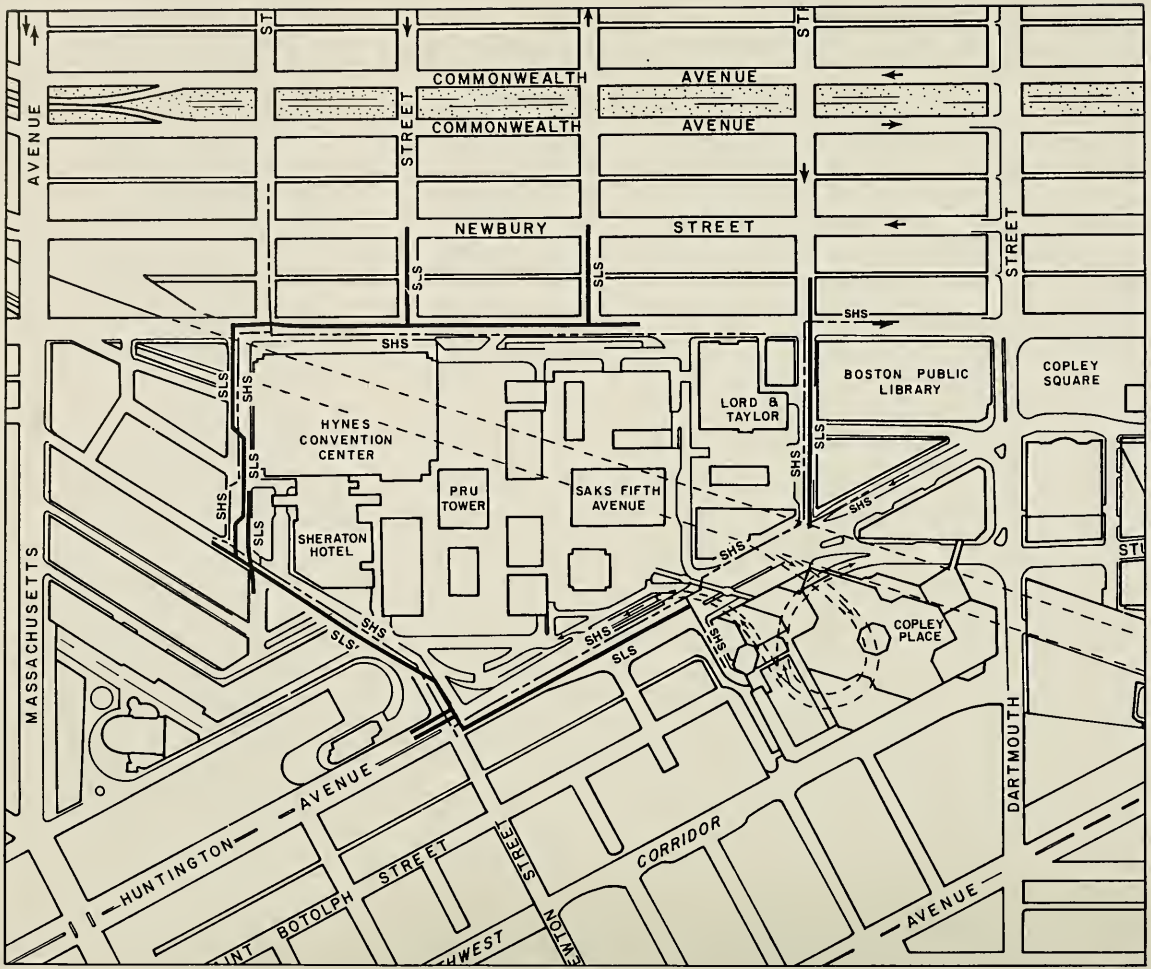
Existing water service to the Prudential Center for domestic use and fire protection is supplied from two separate water systems owned and operated by the Boston Water and Sewer Commission (BWSC). These systems are designated as the Southern Low Service (SLS) supply system, which generally is used to meet domestic water needs and street hydrant demand, and the Southern High Service (SHS) water supply system, which generally services internal building system fire protection requirements.

Domestic water service is provided to the Prudential Center through seven separate connections from the SLS water system located in adjacent streets (see Figure VI-1) to individual structures. The Tower and the Commercial Blocks are served by two connections. The Sheraton, 101 Huntington, Gloucester Apartments, and Lord & Taylor each have a single connection. The Boylston and Fairfield Apartments, and Saks are serviced together by a single connection to the SLS water system. These connections are to a 12 inch line in Boylston street, a 16 inch line in Exeter Street, a 16 inch line in Huntington Avenue, and a 12 inch line in Belvidere Street and Dalton Street. The water lines are generally interconnected around and within the site as shown on Figure VI-1 forming loops that allow water to flow toward any demand point via multiple routes.

The existing Prudential Center fire protection water service is currently supplied to the individual buidings through seven separate connections from the SHS water system located in the adjacent streets (Figure VI-1). These connections are to the 12 inch water line in Boylston Street, the 12 inch line in Exeter Street, the 20 inch line in Huntington Avenue, and the 12 inch line in Belvidere Street. Similar to the SLS system, the lines are interconnected around the site as shown on Figure VI-1. The loops formed by the system allow water to flow toward any service point by more than one route.

2.2 Capacity of Existing Facilities

Discussions with BWSC personnel and recent system-wide studies of hydrant flow tests performed by BWSC indicate that both the SLS and SHS water supply systems in the Back Bay area have adequate capacity to supply the anticipated additional demand for redevelopment. Results of the tests are presented in Table VI-1 and show that system reserve capacity is available to serve the new development maximum demand of approximately 560 gpm. Additionally the typical fire requirements of 1500 gpm can be met at any of the hydrant locations.



Prudential Center Redevelopment

Fig. VI-1
Existing Water Distribution System

SHS — Southern High Service

SLS — Southern Low Service

0 100 200
Scale : feet

TABLE VI-1

HYDRANT FLOW TESTS*

Street/ Location	Service	Test Date	Static Press (psi)	Flow (gpm) @ Resid Press (psi)	Flow (gpm) @ Resid Press of 20 psi**
Fairfield and Boylston	SHS 12"	3/87	96	1460 @ 89	5,300
Garrison and Huntington	SLS 12"	8/87	60	3257 @ 60	9,771
Hereford and Boylston	SHS 12"	1/86	88	1570 @ 55	2,320
Boylston btwn Hereford and Garrison	SHS 12"	8/86	90	2430 @ 77	6,020
Exeter and Boylston	SHS 12"	7/85	88	1580 @ 71	3,345
Blagden near Dartmouth	SHS 12"	4/86	97	2080 @ 92	9,100
Garrison and Huntington	SHS 20"	10/85	96	4050 @ 92	—
Mass Ave btwn Belvidere and St. Germain	SHS 20"	10/87	97	4486 @ 92	21,390

* Test data obtained from BWSC, Boston, MA.

** Calculated by BWSC, Boston, MA..

Discussions with BWSC personnel identified three areas in the vicinity of the Prudential Center complex where the water distribution system configuration could be enhanced. In several instances, the existing water distribution lines are dead–ended and water service cannot be maintained to several users if the line is shut down. These conditions in the system occur on the high service system in the 12 inch SHS line located in Boylston Street, on the low service system in the 12 inch SLS line located in Boylston Street, and on the 16 inch SLS line located in Huntington Avenue. Studies are ongoing into the feasibility of improving these systems as a result of this project by providing multiple route supplies for various Prudential Center and other local service connections. These upgrades are discussed further in Section 2.5.

2.3 Water Use

Two standard systems were considered for obtaining water consumption estimates. A standard system was important for determining current and future use so that a consistent basis is in place for performing comparisons and examining other relationships.

The standard systems considered for estimating water consumption were the State Sanitary Code, Title V* and information developed by Camp Dresser and McKee (CDM)** for the Boston Water and Sewer Commission (BWSC). Water use estimates obtained by using each method are listed in Table VI–2. Comparison between Title V and BWSC/CDM values contained in Table VI–2 indicates that the Title V approach generally provides a significantly higher (i.e., more conservative) estimate of water use. In addition, the BWSC/CDM information does not contain estimating factors for retail space. Therefore, in consideration of the conservative aspect and completeness of the Title V factors, this information was used as the standard basis for generation of existing and new development water use information.

2.3.1 Existing Use and Conservation Practices

Existing average daily water use levels are reported for each structure in Table VI–3. Domestic water requirements are based on Title V estimating factors. Cooling requirements are based on equipment manufacturers performance data and have been calculated for peak cooling requirements for each structure.

---

* Massachusetts State Environmental Code, 310 CMR 15.00, Title V.
** BWSC/CDM Report, May 1987.

TABLE VI-2

AVERAGE DAILY WATER USE FOR EXISTING DEVELOPMENT

Structure	Use Category	Area (gsf)	Title V* (gpd)	BWSC/CDM* (gpd)
Tower	Office	1,520,000	191,000	112,500
101 Huntington	Office	600,000	75,000	44,400
Gloucester	Residential	315,500	50,150	38,800
Boylston	Residential	305,200	48,550	37,500
Fairfield	Residential	315,200	50,050	38,750
Sheraton	Hotel	1,040,000	260,000	275,000
Comm Blocks	Retail	190,000	35,500	27,000
Lord & Taylor	Retail	135,000	13,750	**
Saks	Retail	122,000	13,100	**
TOTALS		4,542,900	737,100	

* Includes peak cooling use.
** Use data not developed.

TABLE VI–3

SUMMARY OF EXISTING AVERAGE WATER USE COMPONENTS

DOMESTIC USE BASED ON TITLE V DATA

Structure	Use Category	Area (gsf)	Average Domestic (gpd)	Peak Cool (gpd)	Total Use (gpd)
Tower	Office	1,520,000	121,000	70,000	191,000
101 Huntington	Office	600,000	45,000	30,000	75,000
Gloucester	Residential	315,500	41,700	8,450	50,150
Boylston	Residential	305,200	40,400	8,150	48,550
Fairfield	Residential	315,200	41,650	8,400	50,050
Sheraton	Hotel	1,040,000	225,000	35,000	260,000
Comm Blocks	Retail	190,000	27,000	8,500	35,500
Lord & Taylor	Retail	135,000	6,750	7,000	13,750
Saks	Retail	122,000	6,100	7,000	13,100
TOTAL		4,542,900	554,600	182,500	737,100*

* Does not include an estimated daily average seasonal outdoor irrigation demand of 40,000 gpd.

Tabulated information has been totaled by structures and type of use. The existing daily domestic requirement for the site is 554,600 gpd. Seasonal peak cooling is determined to be 182,500 gpd.

Another seasonal use is irrigation. An estimate of 40,000 gpd is provided which is variable and depends on seasonal weather conditions and landscape maintenance requirements. The total daily water use for the existing development, less irrigation but including peak cooling, is estimated to be 737,100 gpd.

An important point affecting the current water use at the Prudential Center is the efforts over the years to incorporate active and passive water conservation methods. Table VI–4 lists the retrofit programs of the last 15 years. These efforts have resulted in a water use reduction of approximately 15%.

The reduction in water use required a considerable effort in retrofitting hand basins and showers with water saving devices throughout the Prudential Center. In addition to these activities, operational changes also contributed to water conservation. These included improvements to eliminate condenser water injection cooling, and shutdown of fountains and moats.

An important use for water is the availability of a sufficient supply for fire fighting. Water for fire fighting is supplied through local hydrants as well as an extensive system of piping within individual structures dedicated for this purpose.

2.3.2 Proposed Development

Water use projections for Alternative A are contained in Table VI–5. The information is based on Title V data and organized into the general use categories of office, residential, and retail space. The total expected water use for the new development, including average domestic and peak cooling needs, is 267,600 gpd.

Average daily water requirements for the existing plus the new development are contained in Table VI–6. Total future domestic use is estimated to be 733,000 gpd which amounts to an increase of 33% above existing domestic water use. Total peak cooling water demand for the redeveloped center is estimated to be 271,700 gpd. Thus, a total of 1,004,700 gpd is the anticipated total daily use for a hot summer day when air conditioning requirements are high. This is a 37% increase above existing total use. The 40,000 gpd of seasonal irrigation is expected to drop to 30,000 gpd due to changes in site landscaping.

TABLE VI–4
CONSERVATION EFFORTS – WATER CONSUMPTION
RETROFIT ITEMS

YEAR	ITEM
1973	Installed steam condensate cooling tower make–up system (Tower and 101 Huntington)
1975	Improvements to eliminate condensor water injection cooling
1979	Installed 1000 hand basin water–saver devices (Tower, 101 Huntington, and Commercial Blocks)
1980	Installed 2300 hand basin and shower water saver devices (Apartments)
1985	Shutdown of fountains and moats

TABLE VI-5
AVERAGE DAILY WATER USE FOR NEW DEVELOPMENT
ALTERNATIVE A
DOMESTIC USE BASED ON TITLE V DATA

Use Category	Area (gsf)	Domestic (gpd)	Peak Cool (gpd)	Total Use (gpd)
Office	1,009,100	82,200	59,500	141,700
Residential	404,800	61,050	12,200	73,250
Retail*	267,800	35,150	17,500	52,650
	1,681,700	178,400	89,200	267,600

* Net new space

TABLE VI-6

AVERAGE DAILY WATER USE FOR EXISTING AND NEW DEVELOPMENT

ALTERNATIVE A

Use Category	Domestic Use			Peak Cooling			New Total (gpd)	Site Total (gpd)
	Existing (gpd)	New (gpd)	Total (gpd)	Existing (gpd)	New (gpd)	Total (gpd)		
Office	166,000	82,200	248,200	100,000	59,500	159,500	141,700	407,700
Residential	123,750	61,050	184,800	25,000	12,200	37,200	73,250	222,000
Hotel	225,000	-	225,000	35,000	-	35,000	-	260,000
Retail	39,850	35,150	75,000	22,500	17,500	40,000	52,650	115,000
Total	554,600	178,400	733,000	182,500	89,200	271,700	267,600	1,004,700

Note: Irrigation for existing development is estimated at 40,000 gpd. New development will reduce irrigation to an estimated 30,000 gpd. This is not included in above amounts.

The new development systems requiring water supply will either meet or be an improvement beyond new state building code requirements* designed to minimize water use. Building design features to reduce water use will include new water saving fixtures such as low flow showers, low volume flush systems, and automatic lavatory sink faucets. Use of steam condensate where appropriate for air conditioning cooling tower water make-up, and reduced water use by mechanical systems is also planned. These efforts will result in an expected savings in water use relative to standard systems of approximately 15%.

Water requirements for fire fighting will remain essentially the same for the new development because potential fire fighting scenarios remain the same. As with the existing facility, water to satisfy fire fighting needs will be supplied by local hydrants and individual structure dedicated piping systems. New code standards require sprinkler systems in all new high rise structures.

2.4 Impacts and System Connections

The redevelopment is estimated to require a maximum total increase in water use of 267,600 gpd, average domestic plus peak cooling (see Table VI-6). Discussions with BWSC personnel indicate that the existing supply and distribution system is capable of supplying sufficient water to satisfy the anticipated additional demand. In general, the domestic and cooling flows will be supplied by the SLS system.

Adequate fire flow capacity is expected at the site. Information reported in Table VI-1 clearly indicates a fire flow of 1500 gpm is available at locations surrounding the site. Water for internal building fire fighting systems will generally be provided by the SHS system. Fire booster pumps will be installed where appropriate.

Water service to existing facilities which remain will be maintained during construction. This will be accomplished by maintaining existing waterlines in place, by temporary relocation of waterlines out of impact areas, or by replacement of an existing system by a new facility. Service to proposed structures will be supplied by the construction of separate service connections to the BWSC distribution system in adjacent roadways with distribution systems developed on site to each of the major facilities. Modifications to existing service connections, construction of new service connections and

---

* Massachusetts State Building Code, 780 CMR.

system improvements will be incorporated into the general build out schedule for the Prudential Center Redevelopment to minimize impacts on adjacent roadways. All modifications to existing systems and construction of new systems will be in accordance with BWSC standards and practices.

2.5 System Improvements and Mitigation Measures

The planned new structures will meet all new code requirements for installation of low flow equipment to conserve water use. In addition, the developer plans to use its water resources as effectively as possible and will evaluate various operational approaches such as the use of steam condensate for cooling tower water make–up.

The developer will continue to study the feasibility of upgrading the existing BWSC distribution network including the installation of segments of pipe as shown on Figure VI–2 to complete the looping of both the SHS and SLS distribution systems around the project site. This will allow each of the developer's service connections, as well as existing service connections to both the Prudential Center and adjacent properties, to be fed by the BWSC systems from multiple directions.

These system improvements will provide an important public benefit by enhancing system flow characteristics and increasing both safety and convenience in the event of a water main break. These potentially costly improvements will be considered in terms of the overall level of development permitted on the site and the multiple needs for infrastructure improvements in the project area.

2.6 Evaluation of Redevelopment Alternatives

Average daily water use, which is reported in Table VI–6 for Alternative A, is presented in Table VI–7 for all alternatives under consideration by the developer. Using the tabulated information for comparison and evaluation, it is clear that Alternative A contains the largest area and has the greatest impact on the water supply system. Alternative C is the smallest option and, therefore, has the least impact on the BWSC infrastructure system. Based on the system information provided, the general conclusions regarding the impact on the water supply associated with Alternate A would not be significantly different for any other alternative. The chief impact of selecting a different alternative would be a change in service connections for individual structures.

Prudential Center Redevelopment

Fig. VI-2
Proposed Improvements Water Distribution System

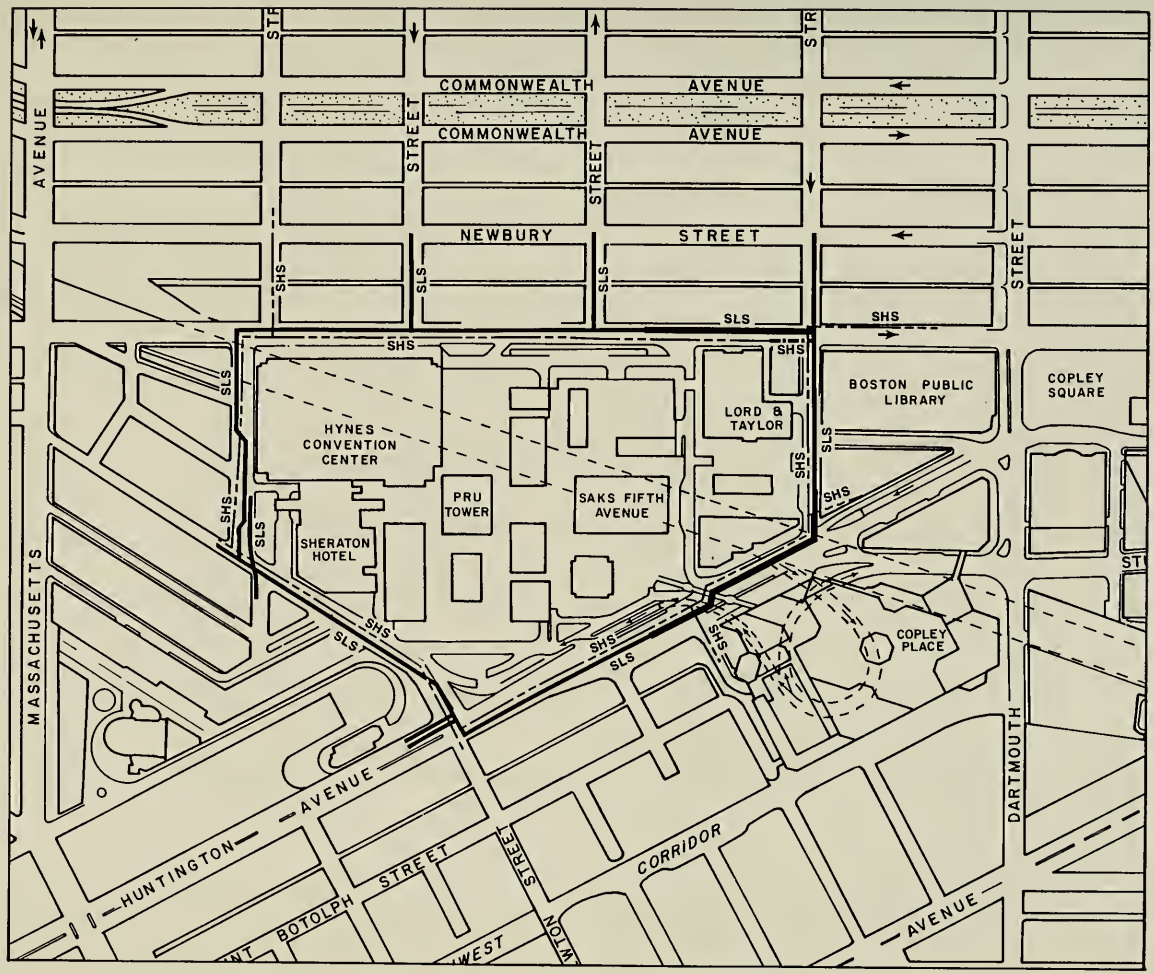


TABLE VI–7

AVERAGE DAILY WATER USE

COMPARISON OF ALTERNATIVES

Use Category	Alternative A		Alternative A2		Alternative B		Alternative B2		Alternative C		Alternative C2	
	(gsf)	(gpd)	(gsf)	(gpd)	(gsf)	(gpd)	(gsf)	(gpd)	(gsf)	(gpd)	(gsf)	(gpd)
Office	1,009,100	141,700	1,011,100	142,000	865,100	121,500	865,100	121,500	811,000	113,900	811,000	113,900
Residential	404,800	73,250	396,300	71,700	378,400	68,500	372,800	67,500	324,400	58,700	319,600	57,800
Retail*	267,800	52,650	268,900	52,900	205,400	40,700	225,800	44,600	159,900	32,000	169,400	33,800
Total	1,681,700	267,600	1,676,300	266,600	1,448,900	230,700	1,463,700	233,600	1,295,300	204,600	1,300,000	205,500

* Net new space

3.0 SEWER AND STORM DRAIN SYSTEMS

3.1 Sanitary Sewers

3.1.1 Description of Existing Facilities

The Prudential Center is serviced by BWSC area-wide sewer facilities (Figure VI-3) and local sewers located in Boylston Street, Huntington Avenue and Belvidere Street (Figure VI-4). As in most of the City of Boston, the BWSC sewer system in the Prudential Center area is comprised of both separate sanitary and storm sewer lines and combined sanitary and storm sewer lines. The existing Prudential Center on-site sewage collection systems are all separate sanitary systems. There are approximately 12 separate sanitary sewer connections to the four BWSC systems located around the site. These connections each service separate portions of the complex and carry flows to four different local BWSC collections systems (Figure VI-4) as follows:

Sewer System 1

The Prudential Tower, Fairfield, Boylston and Gloucester apartment buildings and the northern portion of the Prudential Center retail areas discharge to a 30" and 33" x 39" sanitary sewer line in Boylston Street. This line carries flows westward to the combined West Side Intercepter (WSI) at the Boylston Street/Hereford Street/Dalton Street intersection.

Sewer System 2

The 101 Huntington Tower and eastern portions of the southerly Prudential Center retail space discharge to combined sewer systems in Huntington Avenue. These lines discharge to twin 30" lines which, acting as siphons, carry flows northerly, beneath the Center to twin 36" lines, which also act as siphons, and carry flows northerly under the MBTA's Boylston Street Green Line tunnel to a 60" x 72" and 72" x 78" combined sewer line in Fairfield Street. This conduit carries flows northward to the WSI at the Beacon Street/Fairfield Street intersection.

Prudential Center Redevelopment

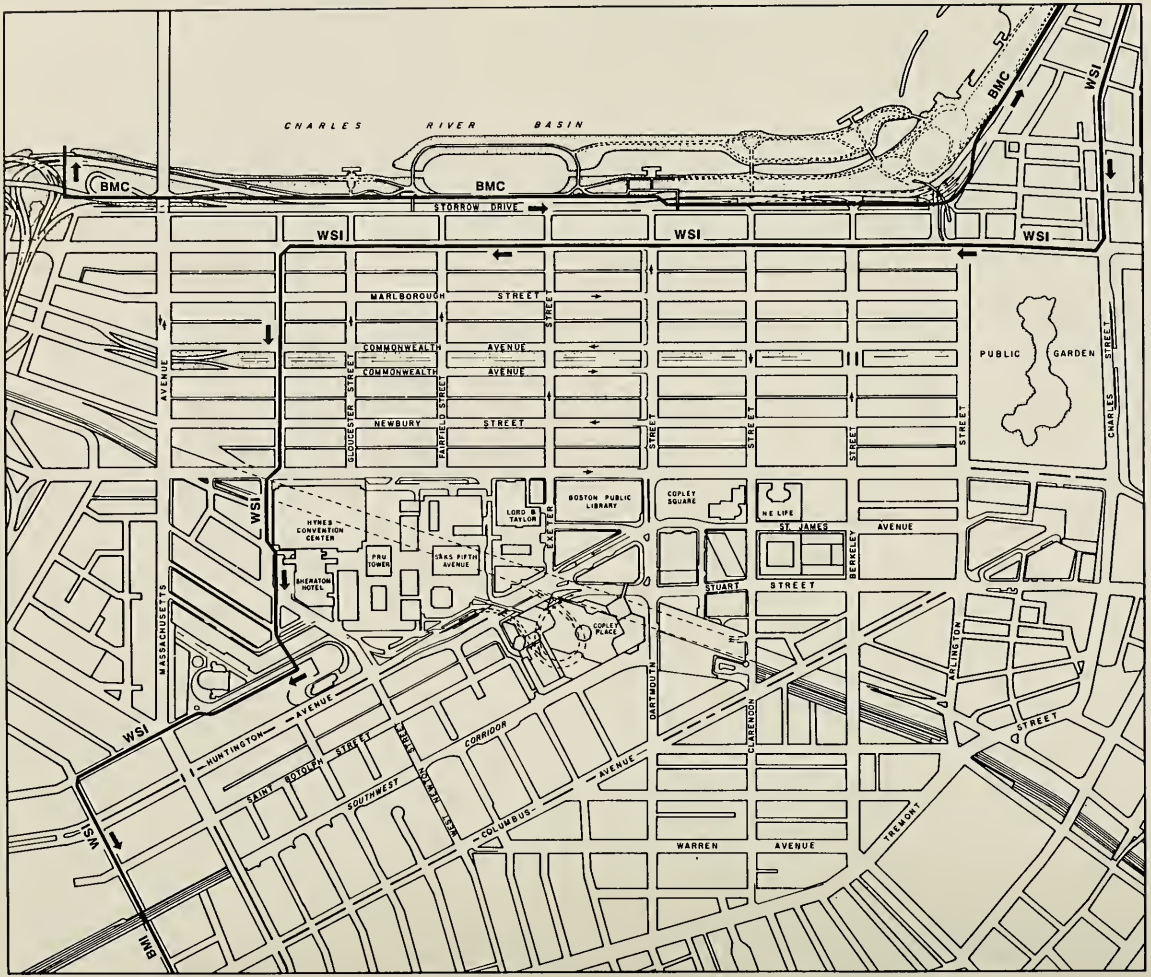


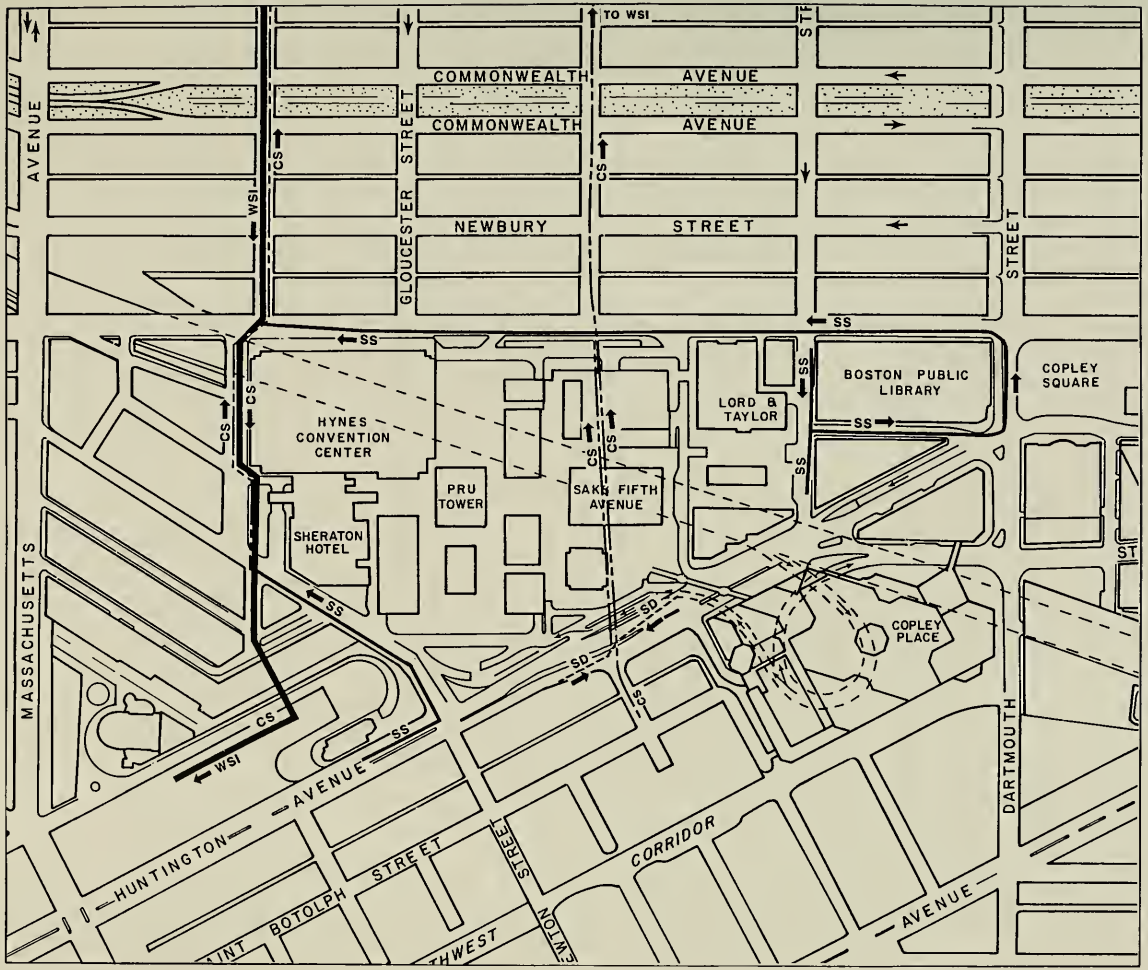
Fig. VI-3
Major Interceptors Sanitary Sewer and Storm Drain System

——— **Major Interceptor**

0 200 400
Scale : feet

Prudential Center Redevelopment

Fig. VI-4
Existing Local Sewer System



SS — Sanitary Sewer
CS — Combined Sewer
SD — Storm Drain
WSI — Major Interceptor

0 100 200
Scale : feet

Sewer System 3

The western portions of the southerly Prudential Center retail area and the southerly portion of the Sheraton Hotel complex discharge to a 24" and 27" sanitary sewer line in Belvidere Street which carries flows westward to a 54" combined sewer line at the Belvidere Street/Dalton Street intersection. This sewer line carries flows northward in Dalton Street and Hereford Street to the WSI at the Beacon Street/Hereford Street intersection.

Sewer System 4

The northerly portion of the Sheraton Hotel complex discharges directly to the 54" combined sewer line described above, which carries flows northward in Dalton Street and Hereford Street and discharges to the WSI.

3.1.2 Capacity of Existing Facilities

An evaluation was made of the capacity of applicable segments of the existing sanitary and combined sewers servicing the Prudential Center area. Results of this evaluation are given in Table VI–8. The analysis was based on data for the existing systems taken from BWSC plans.

Results of the capacity analysis generally show that there is adequate capacity to accept additional sanitary flows discharged to the existing sewer systems servicing the Prudential Center. However, discussions with BWSC representatives indicate that two of the existing systems have historically experienced difficulties in handling flows, or are anticipated to experience problems in the future as a result of additional volumes or maintenance problems. These systems are the Exeter Street/Blagden Street/Dartmouth Street portion of the sanitary sewer system and the twin 30" and twin 36" combined sewer siphons which, respectively, pass under the Prudential Center and the MBTA Boylston Street Green Line tunnel.

The Exeter Street/Blagden Street/Dartmouth Street sewer does not currently serve the Prudential Center directly. It services Exeter Street addresses adjacent to the Prudential Center. However, it may serve the easterly portion of the proposed redevelopment. The difficulty with this line is that historically it has experienced times when it has operated against a downstream surcharged condition.

TABLE VI-8

EXISTING SEWER SYSTEM CAPACITY

Segment MH-MH	Street Location	Sewer Size (in)	Segment Length (ft)	Slope Ft/Ft	Capacity (mgd)	Sewer Type
Boylston Street Sewer						
20-7	Exeter	12	185	0.00768	1.75	Sanitary
7-17	Blagdon	12	385	0.00158	0.80	Sanitary
17-15	Blagdon	12	165	0.00406	1.27	Sanitary
15-42	Blagdon	15	60	0.06450	2.43	Sanitary
42-365	Dartmouth	30	190	0.00084	6.67	Sanitary
365-319	Boylston	30	475	0.00082	6.58	Sanitary
317-27	Boylston	30	100	(0.00078)	6.40	Sanitary
27-25	Boylston	48x24	80	(0.00027)	6.40	Sanitary
25-24	Boylston	30	40	(0.00078)	6.40	Sanitary
24-104	Boylston	30	200	(0.00098)	7.22	Sanitary
104-103	Boylston	30	195	(0.00098)	7.22	Sanitary
103-102	Boylston	30	190	(0.00105)	7.45	Sanitary
102-100	Boylston	33x39	360	(0.00083)	10.78	Sanitary
100-99	Boylston	33x39	240	(0.00125)	13.21	Sanitary
99-93(WSI)	Boylston	33x39	500	Unknown	—	Sanitary
Fairfield Street Sewer						
438-14	Garrison	24x31	270	0.00222	9.00	Combined
14-18	Garrison	24x31	140	0.00571	14.40	Combined
18-19	Huntington	48x48	65	0.01308	117.00	Combined
19-SC125	Huntington	72	20	0.0025	28.20	Combined
SC25-SC111	Pru Center	2-30	880	(0.00477)	31.70	Combined
SC111-SC112	Boylston	2-36	55	(0.00180)	31.70	Combined
SC112-SC118	Fairfield	60x72	145	(0.00131)	71.20	Combined
118-66	Fairfield	60x72	305	0.00131	71.20	Combined
66-82	Fairfield	60x72	465	0.00086	57.70	Combined
82-MC19	Fairfield	72x78	430	0.00246	135.00	Combined
MC19-110(WSI)	Fairfield	—	25	Unknown	—	Combined

- Continued -

TABLE VI–8
(Continued)

Segment MH–MH	Street Location	Sewer Size (in)	Segment Length (ft)	Slope Ft/Ft	Capacity (mgd)	Sewer Type
Belvidere Street Sewer						
30–32	Belvidere	24	320	0.00084	3.68	Sanitary
32–34	Belvidere	27	410	0.00058	3.07	Sanitary
See Hereford Street combined sewer at MH34 for continuation.						
Hereford Street Sewer						
34–70	Dalton	51x60	80	Unknown	—	Combined
70–69	Dalton	54	150	0.00160	74.10	Combined
69–68	Dalton	54	70	0.00429	72.10	Combined
68–67	Dalton	54	250	0.00620	86.80	Combined
67–SC97	Dalton	43.5x68	215	Unknown	—	Combined
SC97–SC252	Hereford	Unknown	50	Unknown	—	Combined
SC252–129	Hereford	Unknown	130	Unknown	—	Combined
129–130	Hereford	72x72	305	0.00098	74.40	Combined
130–36	Hereford	72x78	200	0.00070	71.70	Combined
36–33	Hereford	72x78	255	0.01133	289.00	Combined
33–32	Hereford	96x102	150	0.00033	103.00	Combined
32–27	Hereford	96x102	150	0.00020	80.00	Combined
27–26	Hereford	96x102	110	Unknown	—	Combined
26–MC23	Hereford	—	20	Unknown	—	Combined
MC23–41(WSI)	Hereford	24	25	Unknown	—	Combined

The twin sewer siphons below Prudential Center carry local combined flows from a portion of the St. Botolph Street area and Huntington Avenue for discharge to the sanitary sewer line in Boylston Street. These siphons have experienced chronic sedimentation problems which reduce the flow in one line to zero and restrict the other to approximately 40% of design capacity. Because of these difficulties, the twin siphon system is addressed in Section 3.1.5, System Improvements and Mitigation.

3.1.3 Project Wastewater Generation

The majority of wastewater generated by the existing and new developments is domestic sewage. A small but additional identifiable discharge to the BWSC sewer system is the seasonal cooling tower water blowdown generated by air conditioning system operations.

During summer periods all steam condensate generated at the site is used as make-up for the cooling towers. In winter there is a net discharge of steam condensate because of the additional amounts generated by steam heating and the reduction in cooling tower requirements.

Existing Wastewater Generation

Results of the analysis of existing wastewater generation are reported in Table VI-9. The domestic sewage estimates are based on Title V information (see Section 2.3), and the cooling blowdown and steam condensate generated are based on common mechanical engineering factors.

Information in Table VI-9 is listed by structure with estimates separated into office, residential and retail use. Restaurants outside of the hotel are included in the retail category. Total sewage discharge for the existing development is calculated to be 554,600 gpd and peak cooling is 62,100 gpd. Peak cooling blowdown will occur only on warm summer days, whereas the sewage flow is an estimated daily average which can be expected to occur on any day during the year. The peak steam condensate discharge of 115,000 gpd will occur during the winter season.

Proposed Development

Wastewater generation estimates for the Alternative A new development option were obtained in a similar fashion to the estimates of current discharges and, therefore, provide a standard base of comparison. Results of the calculations are reported in Table VI-10.

TABLE VI–9

WASTEWATER GENERATION INFORMATION

EXISTING DEVELOPMENT

SEWAGE GENERATION BASED ON TITLE V DATA

Structure	Use Category	Area (gsf)	Sewage (gpd)	Peak Cooling Blow Down (gpd)	Total Wastewater (gpd)
Tower	Office	1,520,000	121,000	22,800	143,800
101 Huntington	Office	600,000	45,000	9,000	54,000
Gloucester	Residential	315,500	41,700	3,150	44,850
Boylston	Residential	305,200	40,400	3,050	43,450
Fairfield	Residential	315,200	41,650	3,100	44,750
Sheraton	Hotel	1,040,000	225,000	15,000	240,000
Comm Blocks	Retail	190,000	27,000	3,000	30,000
Lord & Taylor	Retail	135,000	6,750	1,500	8,250
Saks	Retail	122,000	6,100	1,500	7,600
Totals		4,542,900	554,600	62,100	616,700

Note: Winter operations provide steam condensate in lieu of summer cooling blowdown. The additional net discharge of 115,000 gpd is not included in the above total wastewater amount.

TABLE VI–10

WASTEWATER GENERATION INFORMATION FOR NEW DEVELOPMENT

ALTERNATIVE A

SEWAGE GENERATION BASED ON TITLE V DATA

Use Category	Area (gsf)	Sewage (gpd)	Peak Cooling Blow Down (gpd)	Total Wastewater (gpd)
Office	1,009,100	82,200	17,750	99,950
Residential	404,800	61,050	3,750	64,800
Retail*	267,800	35,150	5,250	40,400
Totals	1,681,700	178,400	26,750	205,150

Note: Winter operations provide steam condensate in lieu of summer cooling blowdown. The additional net discharge of 25,000 gpd is not included in the above total wastewater amount.

* Net new development

Average daily sewage generation is estimated to be 178,400 gpd and seasonal peak cooling blowdown is expected to be 26,750. Peak seasonal steam condensate discharge is expected to be 25,000 gpd.

Table VI–11 summarizes information for the existing and proposed new development. Total expected sewage generation is 733,000 gpd. Total blowdown from peak summer cooling is estimated at 88,850 gpd. Total peak wastewater flow is the sum of these two amounts, 821,850 gpd, and will occur during hot summer periods. The peak steam condensate discharge of 140,000 gpd is an additional amount which is produced during the winter heating season.

3.1.4 Impacts and System Connections

The new development will contribute a maximum increase in wastewater flow of approximately 205,150 gpd, an increase of 33% above existing conditions. This estimated flow has been reduced by the moderating effects of water conservation components factored into the building designs. The BWSC believes that the increase in sewage flow can be accommodated by the existing system particularly if the improvements described in Section 3.2.4 are implemented.

Existing sewer connections from the Prudential Center, which are to remain, will be maintained during construction of the new facilities. However, if there is a conflict with proposed construction activities, they will be relocated out of the impact area before construction begins.

New service connections will be constructed during the construction of each new facility as required. The construction of these connections will be incorporated in the general Prudential Center construction phasing in order to minimize impacts on adjacent streets and to ensure that adequate facilities are available as required to service the site.

3.1.5 System Improvements and Mitigation Measures

The developer is prepared to consider major improvements to the systems servicing the southern and eastern portion of the Prudential Center site, the Garrison Street/Harcourt Street/St. Botolph Street neighborhood of the Back Bay, and Exeter Street between Huntington Avenue and Boylston Street. These improvements must, of course, be weighed against the amount of development permitted on the site and competing infrastructure improvement priorities.

TABLE VI-11
WASTEWATER GENERATION INFORMATION
FOR EXISTING AND NEW DEVELOPMENT
ALTERNATIVE A

Use Category	Sewage			Peak Cooling Blow Down			New Total	Site Total
	Existing (gpd)	New (gpd)	Total (gpd)	Existing (gpd)	New (gpd)	Total (gpd)	(gpd)	(gpd)
Office	166,000	82,200	248,200	31,800	17,750	49,550	99,950	297,750
Residential	123,750	61,050	184,800	9,300	3,750	13,050	64,800	197,850
Hotel	225,000	–	225,000	15,000	–	15,000	–	240,000
Retail	39,850	35,150	75,000	6,000	5,250	11,250	40,400	86,250
Totals	554,600	178,400	733,000	62,100	26,750	88,850	205,150	821,850

NOTE: Winter operations provide steam condensate in lieu of summer cooling blowdown. The additional net discharge of 140,000 gpd is not included in the above total wastewater amount.

The redevelopment will also comply with the Massachusetts Water Resources Authority (MWRA) expressed goal of reducing the inflow of storm water and/or infiltration of ground water into their sewage collection system in return for the allowance of additional sanitary sewage to enter the system. This goal is generally referred to as the 2 for 1 I/I (Infiltration/Inflow) program which means that I/I flow into their system must be reduced at a rate of two times the projected new sanitary sewage flow. It is the developers goal to provide a 78 to 1 reduction at average flow rates and between 4.0 and 4.5 to 1 reduction at peak flows. To accomplish this goal, a number of improvements are planned.

As stated in the existing systems section, the current Prudential Center storm and sanitary collection systems are separated on site. In most cases these systems discharge to separate storm and sanitary systems in the adjacent streets. However, the system in the area of the site around 101 Huntington discharges to systems which carry flows to the combined sewer siphons which also transport flows collected in the Garrison Street/Harcourt Street/St. Botolph Street portion of the Back Bay area under the Prudential Center. This double inverted siphon system has been identified as a concern by BWSC due to the reduction in its carrying capacity from sedimentation and the anticipated expense and technical problems associated with its cleaning.

It is proposed that a new system be installed to divert both the existing and proposed Prudential Center flows and Back Bay area flows from this siphon system using a new line along Huntington Avenue and Belvidere Street to the West Side Interceptor (W.S.I.) and the adjacent counterflow storm drain line. It is also proposed that a flow separation facility be constructed at the location where the Back Bay flows enter this system to separate dry weather (sanitary) flows and wet weather (storm) flows before they enter the system. The existing Prudential Center and neighborhood collection systems in the area would be diverted to this new system and any new collection systems needed would connect to these new separate systems. These improvements will allow the abandonment of the twin 30" siphon system under the Prudential Center and thus remove a potential problem from the BWSC collection system.

In addition, studies are ongoing into the feasibility of the installation of a new sanitary sewer in Exeter Street to carry discharges both from the most easterly portion of the redeveloped Prudential Center and from other adjacent facilities. Flow will be northward to the Boylston Street/Exeter Street intersection where it will discharge to the

existing sanitary system which carries flows westward to the WSI at the Boylston Street/Hereford Street/Dalton Street intersection. This will allow the diversion of flows away from the existing Blagden Street/Dartmouth Street system segment which presently is surcharged during high flow periods. The proposed systems modifications are shown on Figure VI–5. All modifications will be designed and constructed in accordance with BWSC standards and practices.

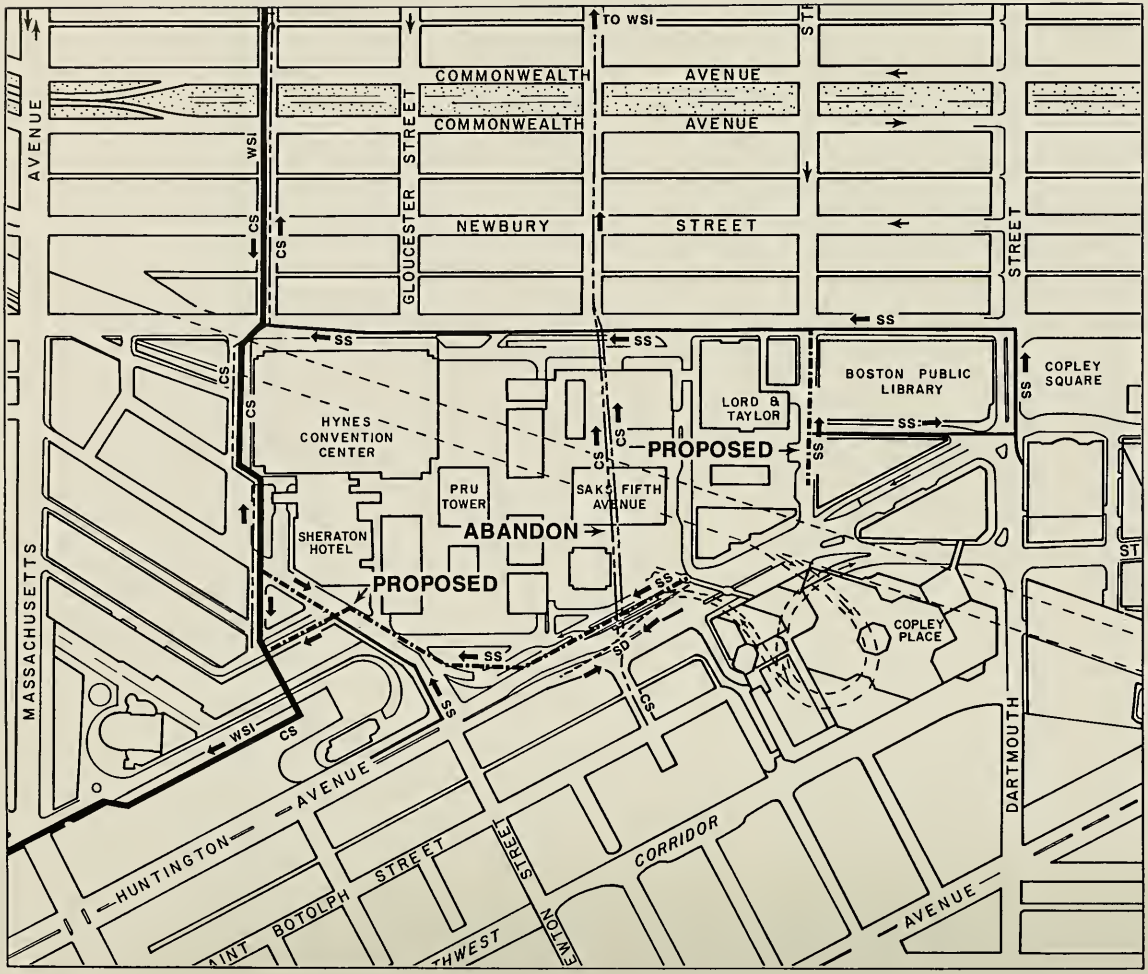
These system improvements will allow for the separation from the BWSC system of storm drainage from approximately 4.0 acres of the existing Prudential Center and from approximately 13.5 acres of the Garrison Street/Harcourt Street/St. Botolph portion of the Back Bay.

Assuming a 10 year design storm, these systems will result in the separation of storm drainage at the rate of 3400 gpm from the Prudential site and 11,400 gpm from the Garrison Street system for a total of 14,800 gpm. Comparing these flow rates to the projected average (190 gpm) and peak (3420 gpm) sanitary flow rates from the proposed development program results in I/I reduction ratios of approximately 78 to 1 for the average flow rate and between 4 and 4.5 to 1 for peak flows which is well beyond the standard 2 to 1 I/I reduction goals.

3.2 Storm Drains

3.2.1 Description of Existing Facilities

The Prudential Center is serviced by BWSC storm drainage facilities located adjacent to the site in Boylston Street, Exeter Street, Huntington Avenue, Belvidere Street and Dalton Street (Figure VI–6). As in most of the City of Boston, the storm drainage system in the Prudential Center area of Back Bay is made up of both separate storm drain collection lines and combined sewers which carry both storm drainage and sanitary sewage. The existing storm drainage collection systems within the Prudential Center site are dedicated storm drains separate from the sanitary collection systems. There are approximately 18 storm drain discharge points from the site into the BWSC collection systems in the adjacent streets. These connections service separate areas of the site and discharge to six different local BWSC storm drain/combined sewer collections systems (Figure VI–6) as follows:

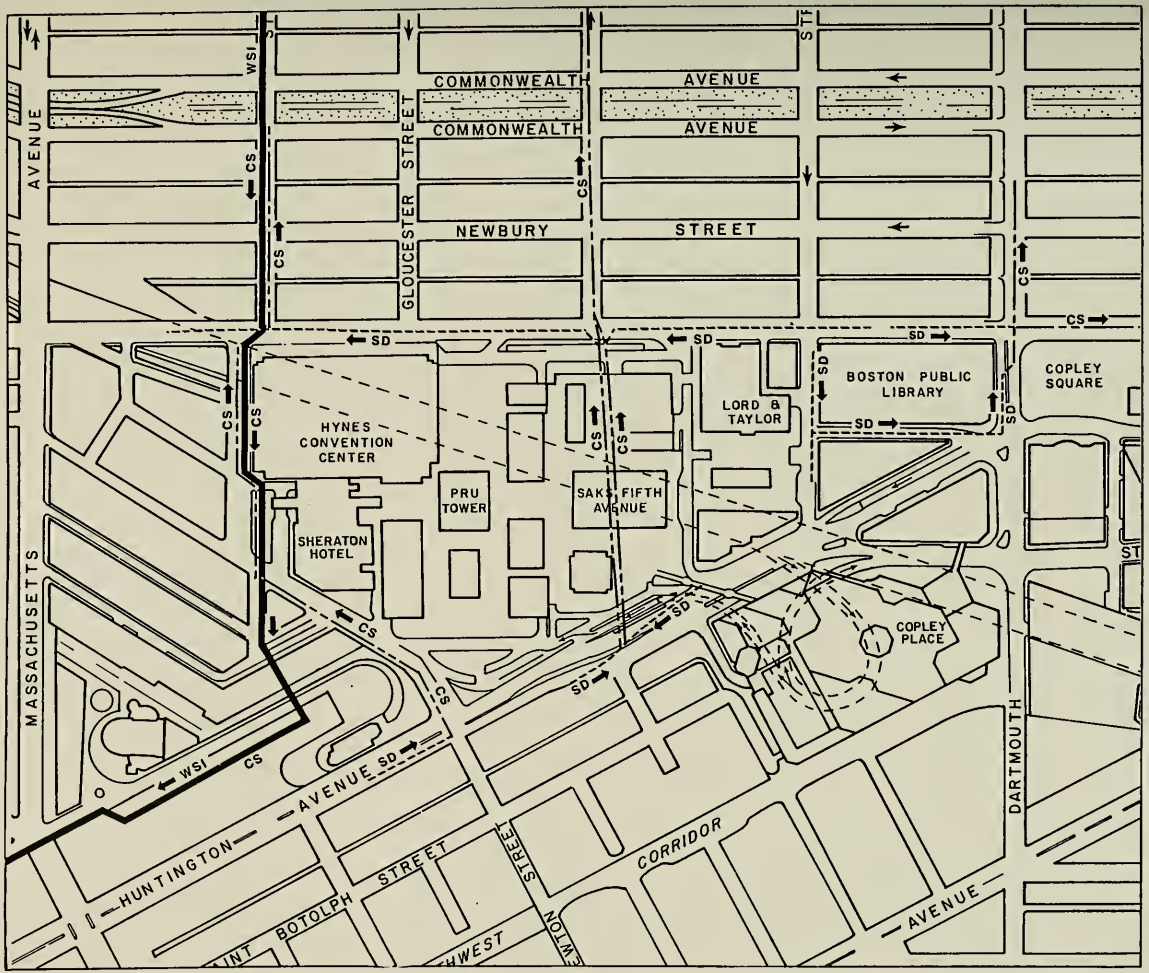


Prudential Center Redevelopment

Fig. VI-5
Proposed Improvements Sanitary Sewer System

SS — Existing Sanitary Sewer
CS — Existing Combined Sewer
SD — Existing Storm Drain
SS — Proposed Sanitary Sewer Modifications
Existing Major Interceptor

0 100 200
Scale : feet



Prudential Center Redevelopment

Fig. VI-6
Existing Storm Drain System

SD ------ Storm Drain
CS —— Combined Sewer
WSI ▬▬ Major Interceptor

0 100 200
Scale : feet

Drain System 1

Storm drainage collected by on–site systems in the northwesterly portion of the Prudential Center in the vicinity of the Prudential Tower and the Fairfield residential building is discharged to a 48" x 100" storm drain in Boylston Street which carries flows westward to a combined sewer line at the Boylston Street/Hereford Street intersection. This sewer line carries flows northward in Hereford Street to the Beacon Street/Hereford Street intersection where it discharges dry weather and lower intensity wet weather flows to the WSI. During high wet weather flow events, this line overflows at the Beacon Street/Hereford Street intersection to an 84" combined sewer line which continues to carry flow northward in Hereford Street to the Boston Marginal Conduit (BMC) located in Storrow Memorial Drive.

Drain System 2

The portion of the Prudential Center around the Boylston apartment building and a portion of Lord & Taylor is drained by on–site systems which discharge to a 20" storm drain in Boylston Street and then flow westward to a 60" x 72" combined sewer at the Boylston Street/Fairfield Street intersection. At this point, the sewer flows northward along Fairfield Street to the Beacon Street/Fairfield Street intersection where it discharges dry weather and lower volume wet weather flows to the WSI. During high volume wet weather events, this line overflows to a 36" x 48" combined sewer which continues northward in Fairfield Street through a 43" x 43" conduit to the BMC in Storrow Drive.

Drain System 3

The portion of the Prudential Center located east of Ring Road, in the vicinity of the Gloucester apartment building, and portions of Lord & Taylor are drained by separate on–site systems which discharge to a 15" storm drain in Exeter Street. This line carries flows southward to the Exeter Street/Blagden Street intersection where it connects to an 18" storm drain, connected to a 27" x 27" storm drain which transports flows eastward, along Blagden Street to a 36" x 36" storm drain at the Dartmouth Street/St. James Street/Huntington Avenue intersection. From this location, flow is transported northward and discharges to a 48" x 51" drain in

Dartmouth Street and continues northward to the Boylston Street/Dartmouth Street intersection. Here it discharges to a 44" x 70" storm drain that carries flows eastward in Boylston Street to a 72" x 78" combined sewer at the Boylston Street/Berkeley Street intersection. This combined sewer proceeds northward along Berkeley Street to the Beacon Street/Berkeley Street intersection where it discharges dry weather and lower volume wet weather flows to the W.S.I. During higher volume wet weather events, this line overflows to a 48" x 60" combined sewer which continues northward in Berkeley Street and discharges to the BMC in Storrow Drive.

Drain System 4

The portion of the Prudential Center located west of Ring Road adjacent to 101 Huntington is drained by separate on–site storm drain systems which discharge to storm drains located in Huntington Avenue. These drains carry flows to twin 30" combined sewer siphons that transport flows northward beneath the Prudential Center to twin 36" inverted siphons below the MBTA Boylston Street Green Line tunnel. Flows are then routed northward to the WSI and BMC as described in 2 above.

Drain System 5

The southwesterly portion of the Prudential Center site and southerly portions of the Sheraton Hotel complex are drained by separate on–site storm drain systems which discharge to a 48" and 54" storm drain in Belvidere Street. This line transports flows westward to a combined sewer line at the Belvidere Street/Dalton Street intersection. This combined sewer carries flows northward as described in 1 above to the WSI and BMC.

Drain System 6

The northerly portion of the Sheraton hotel complex is drained by separate on–site storm drain systems that discharge directly to the BWSC system in Dalton Street described in 5 above, which carries flows northward to the WSI and BMC.

3.2.2 Capacity of Existing Facilities

A capacity evaluation was made for all applicable portions of the existing storm drain system servicing the Prudential Center. The results are provided in Table VI–12. The analysis was based on data for the existing systems taken from BWSC plans.

Results of the evaluation indicate adequate capacity in the existing storm drainage system components servicing the Prudential Center site area. This was confirmed through discussions with BWSC personnel. They indicated that these lines generally have not experienced major flow handling problems in the past.

The discussions with BWSC personnel also led to identification of two system segments which either have experienced problems or where potential problems have been identified. These locations are the Exeter Street, Blagden Street, Dartmouth Street portion of the storm drain system servicing the portion of the site adjacent to Gloucester residential building, and the twin 30" siphons which carry combined discharge, storm drainage and sanitary sewage flows below the Prudential center and the MBTA Boylston Street Green Line tunnel, respectively.

The Exeter Street system is of concern because it is adversely impacted by flows entering its downstream portions from the system located in St. James and by a weir system located in Dartmouth Street which is designed to aid in recharging storm drainage flows into the groundwater table in the Copley Square area. This recharge is required to maintain saturated conditions to preserve wooden piles which support buildings in the area.

The twin siphon system is of note because the accumulation of sediment over the years has significantly reduced its carrying capacity; and, because of its length, it is extremely difficult and expensive to maintain. These problems will be addressed as a result of the redevelopment project, as discussed in Section 3.1.5.

3.2.3 Impacts and System Connections

No additional storm run–off will be generated by the redevelopment site alterations because the entire site is already built–up and drained through the BWSC system. An effort will be made to manage storm water in such a manner that the capacity of the existing functioning system will not be exceeded at any particular location.

Storm drain service to the existing site will be provided at all times during redevelopment by either maintaining the existing service system in place, by temporary relocation or substitution of the system, or by replacement of the existing system by a new system.

TABLE VI-12

EXISTING STORM DRAIN SYSTEM CAPACITY

Segment MH-MH	Street Location	Sewer Size (in)	Segment Length (ft)	Slope Ft/Ft	Capacity (mgd)	Sewer Type
Boylston Street Storm Drain (MBTA): Segment 1						
117-100	Boylston	48x100	265	Unknown	—	Drain
100-99	Boylston	48x100	240	0.00083	69.40	Drain
99-SC97	Boylston	48x100	780	Unknown	—	Drain
SC97-SC252	Hereford	Unknown	50	Unknown	—	Combined
SC252-129	Hereford	Unknown	130	Unknown	—	Combined
129-130	Hereford	72x72	305	0.00098	74.40	Combined
130-36	Hereford	72.78	200	0.00070	71.70	Combined
36-33	Hereford	72x78	255	0.01133	289.00	Combined
33-32	Hereford	96x102	150	0.00033	103.00	Combined
32-37	Hereford	96x102	150	0.00020	80.00	Combined
27-MC24	Hereford	96x102	110	Unknown	—	Combined
MC24-MC23	Hereford	24	20	Unknown	—	Combined
MC23-41(WSI)	Hereford	24	20	Unknown	—	Combined
MC24-17	Hereford	—	50	Unknown	—	Combined
17-15	Hereford	84	210	Unknown	—	Combined
15-16(BMC)	Storrow	51x51	45	Unknown	—	Combined
Boylston Street Storm Drain (MBTA): Segment 2						
105-106	Boylston	15	135	0.00296	1.97	Drain
106-103	Boylston	18	180	0.00333	3.40	Drain
103-107	Boylston	20	200	0.00030	4.25	Drain
107-108	Boylston	20	90	Unknown	—	Drain
108-SC111	Boylston	30	10	Unknown	—	Drain

- Continued -

TABLE VI-12 (Continued)

Segment MH-MH	Street Location	Sewer Size (in)	Segment Length (ft)	Slope Ft/Ft	Capacity (mgd)	Sewer Type
Boylston Street Storm Drain (MBTA): Segment 2 (Continued)						
SC111-SC112	Boylston	2-36	55	(0.00180)	31.70	Combined
SC112-118	Fairfield	60x72	145	(0.00131)	71.20	Combined
118-66	Fairfield	60x72	305	0.00131	71.20	Combined
66-82	Fairfield	60x72	465	0.00086	57.70	Combined
82-MC19	Fairfield	72x78	430	0.00246	135.00	Combined
MC19-110(WSI)	Fairfield	—	25	Unknown	—	Combined
MC19-MC21	Fairfield	36x48	20	Unknown	—	Combined
MC21-127	Fairfield	36x48	180	Unknown	—	Combined
127-136(BMC)	Storrow	43x43	80	Unknown	—	Combined
Berkeley Street Drain						
23-22	Exeter	15	85	Unknown	—	Drain
22-1	Exeter	20	145	Unknown	—	Drain
9-8	Exeter	12	140	(0.01417)	2.38	Drain
8-1	Exeter	12	40	(0.01417)	2.38	Drain
1-17	Blagden	18	370	0.00013	0.68	Drain
17-CZ40	Blagden	27x27	175	Unknown	—	Drain
CZ40-CZ39	Blagden	27x53	20	Unknown	—	Drain
CA39-6	Blagden	27x27	15	Unknown	—	Drain
6-309	Dartmouth	36x36	110	0.00027	6.17	Drain
309-187	Dartmouth	72	135	Unknown	—	Drain
187-186	Dartmouth	72(?)	30	Unknown	—	Drain
186-185	Boylston	44x70	290	(Unknown)	—	Drain
185-181	Boylston	44x70	935	0.00171	54.30	Drain

- Continued -

TABLE VI–12 (Continued)

Segment MH–MH	Street Location	Sewer Size (in)	Segment Length (ft)	Slope Ft/Ft	Capacity (mgd)	Sewer Type
Berkeley Street Drain (Continued)						
181–193	Berkeley	72x78	180	Negative	—	Drain
193–199	Berkeley	72x78	115	0.00017	55.30	Drain
199–204	Berkeley	72x78	175	0.00016	108.00	Combined
204–212	Berkeley	72x78	470	0.00085	79.00	Combined
212–226	Berkeley	72x78	310	0.00129	97.40	Combined
226–MC12	Berkeley	72x78	130	Unknown	—	Combined
MC12–225WSI	Berkeley	—	20	Unknown	—	Combined
MC12–MC13	Berkeley	—	20	Unknown	—	Combined
MC13–207	Berkeley	48x60	210	Unknown	—	Combined
207–RE209 (BMC)	Berkeley	2–30	10	Unknown		
Huntington Avenue to Boylston Drain (Sewer)						
18–19	Huntington	48x48	65	0.01308	117.00	Combined
19–SC25	Huntington	72	20	0.0025	28.20	Combined
SC25–SC111	Pru Center	2–30	880	(0.00477)	31.70	Combined
See Boylston Street Drain/Sewer Segment 2 at MH SC111 for continuation.						
Belvidere Street Storm Drain						
37–35	Belvidere	48	335	0.00079	22.40	Drain
35–34	Belvidere	54	380	0.00055	25.90	Drain
34–70	Dalton	51x60	80	Unknown	—	Combined
70–69	Dalton	54	150	0.00160	74.10	Combined
69–68	Dalton	54	70	0.00429	72.10	Combined
68–67	Dalton	54	250	0.00620	86.80	Combined
67–SC97	Dalton	43.5x68	215	Unknown	—	Combined
See Boylston Street Drain/Sewer Segment 1 at MH SC97 for continuation.						

3.2.4 System Improvements and Mitigation Measures

System modifications will be implemented (Figure VI–7) and new service connections made that will improve the existing BWSC storm drainage collection system. The proposed modifications as shown will reduce the number of systems servicing the Prudential Center area from the existing six to two. These proposed new systems are:

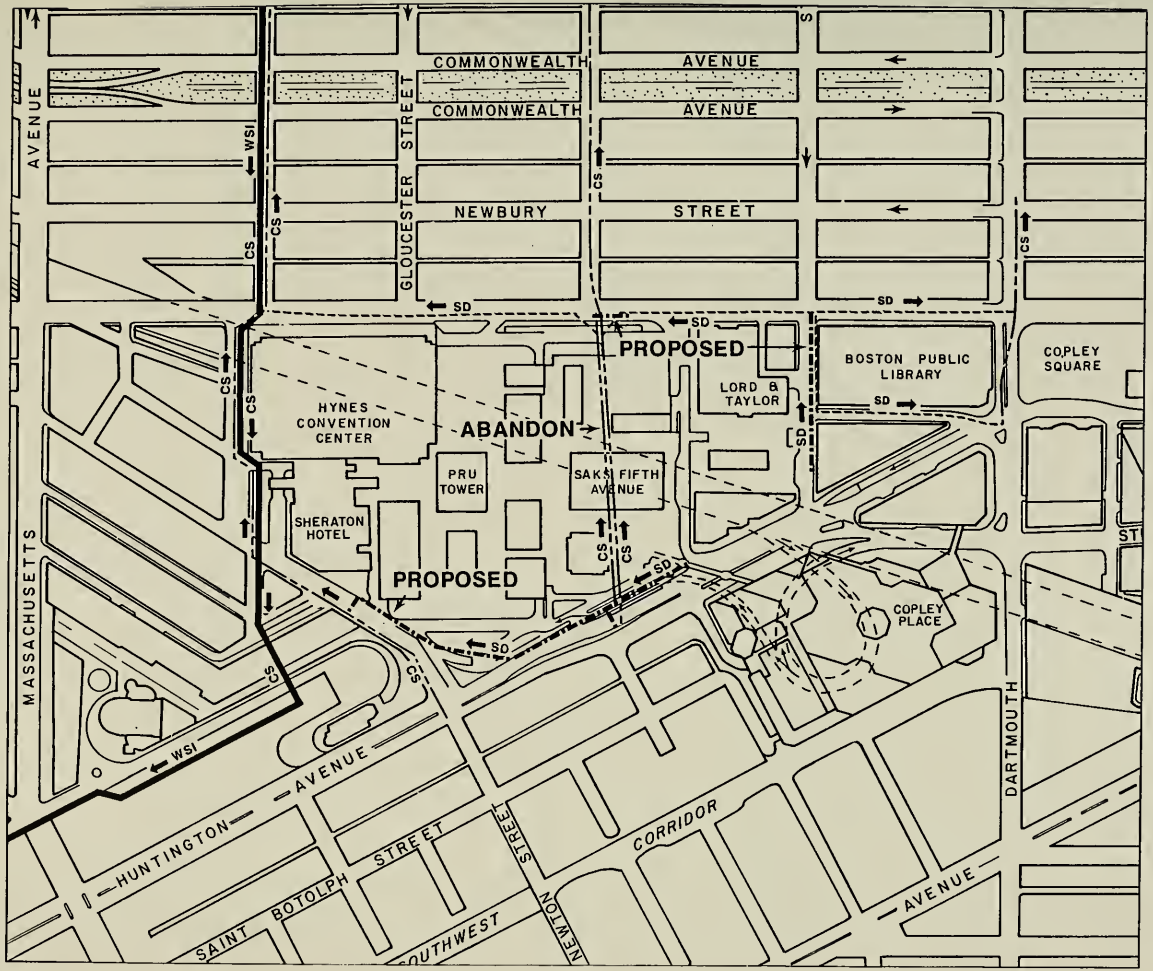
Drain System 1

The feasibility of the installation of a new storm drain in Exeter Street to collect flows from the redeveloped Prudential Center and adjacent facilities is under study. The new line will carry storm flows northward to the Boylston Street/Exeter Street intersection for discharge to the existing storm drain system. From here storm water moves westward to the Boylston Street/Fairfield Street intersection. Additionally, a proposed section of storm drain will bypass the existing Fairfield Street system and carry flows to the storm drain system located further west in Boylston Street. This line will carry storm flows westward to the Boylston Street/Hereford Street/Dalton Street intersection where they will discharge to the existing combined sewer that carries flows northward to the WSI and the BMC.

Drain System 2

A new storm drain is proposed to be installed along the southerly boundary of the site to carry storm drainage flows from the redeveloped Prudential Center and separated wet weather flows from the Garrison Street/St. Botolph Street area of the Back Bay westward to the existing 54" storm drain in Belvidere Street. This line carries flows westward to the Belvidere Street/Dalton Street intersection where it discharges to the existing combined sewer. This combined sewer carries flows in Dalton Street and Hereford Street northward to the WSI and the BMC.

It is anticipated that all new service connection construction and system modifications will be incorporated into the overall Prudential Center redevelopment construction schedule so that they are functional when required to carry flow in the service area of the site. Design and construction of all new storm drain facilities will be completed to BWSC standards and will be subject to its review and approval.



Prudential Center Redevelopment

Fig. VI-7
Proposed Improvements Storm Drain System

SD — Existing Storm Drain
CS — Existing Combined Sewer
SD — Proposed Storm Drain Modification
WSI — Existing Major Interceptor

0 100 200
Scale : feet

3.3 Regional Sewer and Storm Drain Systems

The Prudential Center area of Back Bay is serviced by two major interceptor sewer systems. These sewer lines collect sanitary sewer and storm drainage flows from major portions of Boston and carry them either directly or indirectly to treatment facilities. The major systems servicing the Back Bay are the BWSC West Side Interceptor (WSI) and Boston Main Interceptor (BMI) system, and the Massachusetts Water Resource Authority's Boston Marginal Conduit (BMC) system. These systems are shown on Figure VI–3.

The WSI collects combined sanitary sewage and storm drainage from the west side of Downtown Boston. This major collection system which begins in the North Station area runs generally southerly along Charles Street, Beacon Street, Hereford Street, by the Prudential Center site along Dalton Street, and beneath the Christian Science complex. It then extends along St. Stephens Street and Gainesborough Street to the BMI at the Huntington Avenue/Gainesborough Street intersection.

The BMI transports flows from the WSI southerly along Camden Street to the MWRA's Boston Main Drain Relief Sewer at the Tremont Street/Camden Street intersection. This major trunk sewer carries flows to the Ward Street Headworks, near the Huntington Avenue/Longwood Avenue intersection, where they are discharged to the Boston Main Drainage Tunnel. This tunnel conveys flows to the Deer Island Treatment Facility.

During high volume wet weather flows, when branch sewers carrying flows to the WSI and/or the WSI exceed their carrying capacities, flows overflow into the BMC. The BMC, which is a MWRA facility, begins at the gatehouse adjacent to the Muddy River, west of Massachusetts Avenue and extends along the Charles River Basin, generally along the alignment of Storrow Drive. The BMC collects excess wet weather overflows from combined sewer systems which previously entered the Charles River. These flows are carried by the BMC along the Storrow Drive alignment to north of Leverett Circle where it turns and extends under the Charles River to the Charles River Estuary Pollution Control Facility (CREPCF) near the left bank of the river. This facility also receives excess flows from the Cambridge Marginal Conduit and other combined sewer systems in Cambridge, Charlestown and Somerville. The CREPCF stores the excess wet weather flows in large underground tanks. A pumping station within the facility pumps these flows into the North Metropolitan System at a controlled rate. When flows are greater than the pump rate and the holding capacity of the facility is reached, a large pumping station within the facility is activated and the excess flows are discharged through a force main

to a discharge point downstream of the Charles River Dam. The discharge from the smaller pump station flows by gravity to the Alford Street pump station where it is lifted and flows by way of the Chelsea Creek Headworks and the North Metropolitan Relief Tunnel to the Deer Island Wastewater Treatment facility.

The BMC is designed to overflow through structures located in the Charles River Basin during extreme wet weather flows. MWRA personnel have stated that their ongoing combined sewer overflow (CSO) study has shown no incidents of overflow from any of the structures other than the one located directly at the Muddy River. Their studies have not yet proceeded far enough to determine whether the flows at that location are overflows from the BMC or direct discharge of Muddy River flows into the Charles River.

With implementation of the storm drain and sanitary sewer system modifications adjacent to the Prudential Center site, as previously described, wastewater flows from this area of the Back Bay should be more efficiently carried to these systems. In concept, the sanitary flows will be diverted as far down stream on the WSI as is technically feasible and storm drain flows will be diverted towards the BMC to the greatest extent feasible.

These diversions will assure that the sanitary flows have the greatest possible opportunity of being carried by the WSI to the Deer Island Treatment Facility for treatment before being subject to diversion to the BMC. These system modifications will also reduce the volume of sanitary flows in a portion of the WSI between Boylston Street and Belvidere Street which is subject to deposition of solids.

3.4 Evaluation of Redevelopment Alternatives

The daily level of wastewater generated by each alternative is reported in Table VI-13. Comparing the information for each option, it is evident that Alternative A generates the greatest amount of wastewater. As a result, the overall sewer system impacts reported in this document associated with Alternative A will be somewhat greater than all other alternatives. Service connection requirements for individual structures will vary and depend upon the final alternative selected.

TABLE VI-13

WASTEWATER GENERATION FOR NEW DEVELOPMENT

COMPARISON OF ALTERNATIVES

Use Category	Alternative A		Alternative A2		Alternative B		Alternative B2		Alternative C		Alternative C2	
	(gsf)	(gpd)	(gsf)	(gpd)	(gsf)	(gpd)	(gsf)	(gpd)	(gsf)	(gpd)	(gsf)	(gpd)
Office	1,009,100	99,950	1,011,100	100,100	865,100	85,700	865,100	85,700	811,000	80,300	811,000	80,30
Residential	404,800	64,800	396,300	63,400	378,400	60,600	372,800	79,700	324,400	51,900	319,600	51,20
Retail*	267,800	40,400	268,900	40,600	205,400	31,200	225,800	34,200	159,900	24,500	169,400	25,90
Total	1,681,700	205,150	1,676,300	204,100	1,448,900	177,500	1,463,700	179,600	1,295,300	156,700	1,300,000	157,40

* Net new space

4.0 ENERGY SYSTEMS

4.1 Energy Use Strategies

The Prudential site is currently serviced by Boston Edison Company, Boston Gas Company, and Boston Thermal Energy Corporation. Electricity from Boston Edison is used for lighting, mechanical equipment, and some air conditioning, but not for heat. Boston Gas supplies natural gas for restaurant use and for dedicated on-site laundry services. Heating requirements and a large fraction of existing air conditioning needs are satisfied by steam provided by Boston Thermal Energy.

As part of the redevelopment planning, an effort is underway to select the most appropriate energy mix strategy. Each of the utility suppliers has indicated they have the ability to supply the heating and air conditioning energy requirements for the redevelopment. The discussion to follow is based on the current probable energy mix scenario.

For energy analysis and planning purposes, the existing energy sources/strategies have been maintained for the present development. For the new development, each energy source and potential use have been initially reviewed to generate a probable strategy. Steam from Boston Thermal Energy is expected to continue to be the main source of space heating for the new development, although natural gas is a viable alternative under consideration. However, steam will continue to be evaluated as an alternative energy source for air conditioning. Natural gas will continue to be relied on for restaurants and laundries.

As part of the energy plan for the redevelopment, all new structures are anticipated to have individual energy supply systems. This separate supply strategy provides for more reliable center operation, and flexibility in services for real estate management.

4.2 Description of Existing Systems

4.2.1 Electric Service

The Prudential Center complex is supplied with electric energy by the Boston Edison Company (BECO) from their substation located on Scotia Street between St. Cecilia Street and Dalton Street. Electricity is transmitted from this substation to the Prudential Center area through BECO cable networks in two conduit and manhole systems. One is

located in Dalton Street, Boylston Street and Exeter Street, the other in Dalton Street, Belvidere Street and Huntington Avenue. These two cable networks supply electric energy to transformer vaults located on the north and south sides, respectively, of the Massachusetts Turnpike which bisects the site. These BECO transformers receive electric energy at 13.8 kva and transform it to usable levels of 120v or 480v. Following conversion, electric power is then distributed through Prudential Center cable systems to the end users.

4.2.2 Steam Service

Steam service for the Prudential Center site is supplied by the Boston Thermal Energy Corporation (BTEC) from steam generating plants located on Kneeland Street, near Atlantic Avenue, and on Scotia Street, between Dalton Street and St. Cecilia Street. BTEC distributes steam from their generating plants to the Prudential Center complex through steam lines located primarily around the southern portion of the site. At present, Prudential Center has approximately five service connections to the BTEC distribution system adjacent to the site. This distribution system consists of a 12 inch line in Exeter Street, a 12 inch line in Huntington Avenue and Belvidere Street, a 14 inch line in Belvidere Street and Dalton Street, and a 12 inch line running through the site from the Huntington Avenue/Belvidere Street intersection to the Boylston Street/Gloucester Street intersection.

4.2.3 Natural Gas Service

Low pressure gas is supplied to the Prudential Center area by the Boston Gas Company through a network of gas lines located in many Back Bay streets. The system was originally designed to supply low pressure gas to relatively small volume users in the area and is presently operating near capacity. The Prudential complex has approximately five service connections to separate sections of the Center from Boston Gas lines. These are located in Boylston Street, Exeter Street/Blagden Street, Huntington Avenue, Belvidere Street and Dalton Street. These lines are interconnected throughout the Back Bay to form distribution loops, which allow gas demand to be fed from multiple lines and directions.

4.3 Capacity of Existing Facilities

4.3.1 Electric Service

Initial discussions were held with BECO representatives on September 28, 1988. At that meeting, BECO representatives indicated that the existing BECO substation No. 492 has a rated capacity of 130 mva with a peak loading capacity of approximately 150 mva. During the peak cooling period of the summer of 1988, a peak load of 128 mva was recorded at this location. This event, combined with the general trend of increasing requirements, leads BECO to feel that the current local service system is nearing capacity.

To address potential supply difficulties, BECO presently has a new substation under construction on Chatham Street which is scheduled to come on line in 1989. This will allow transfer of some load from the Scotia Street station to other stations by revising the boundaries between networks. Additionally, BECO is also actively pursuing a location for an additional substation in the Back Bay/South End that would allow them to further adjust existing loads within their system and to accommodate anticipated future demands. They anticipate a three year substation implementation time frame once a site has been identified.

BECO's initial evaluation of their system indicates that there is excess capacity available in their conduit and manhole system to allow additional distribution cables to be installed to serve the proposed new development. With load shifting between network boundaries, BECO expects to be able to accommodate approximately one half of the redevelopment plan as well as other new development in the area before a new substation comes on-line. The evaluation also indicates that the existing Prudential Center service connections and transformer vaults will have to be supplemented to meet the needs of the new development.

4.3.2 Steam Service

Boston Thermal Energy Corporation services the Prudential Center area of the City of Boston from both its Kneeland Street and Scotia Street generating stations. The Kneeland Station is used to supply the base load for their City-wide distribution system, while Scotia Station is used to maintain system pressures in the Back Bay area during peak demand periods. The Kneeland Station has a generating capacity of 1.1 to 1.2 million

lbs/hr and operates on a continuous basis, 365 days a year. The Scotia Station has a generating capacity of approximately 350,000 lbs/hr and is operational the equivalent of 60 to 90 days per year.

Boston Thermal Energy Corporation representatives have indicated that the existing peak loads on their generating system are approximately 35–40% of capacity during the summer cooling peak and 70–75% of capacity during the winter heating peak. Initial evaluations also indicate excess capacity in the Back Bay distribution network, which would be available to serve the Prudential Center redevelopment.

4.3.3 Natural Gas Service

Initial discussions with Boston Gas Company representatives indicate that adequate supplies of gas are available to meet a much greater demand within the city than is presently experienced by their system. The limiting factor which will affect their ability to meet future load requirements in the Prudential Center area is the existing distribution network in the adjacent streets. Initial evaluations indicate that they can meet an additional demand of approximately 30,000 (cubic feet per hour) cfh (approximately 45 x 10^6 cf/yr) but that any significant amount of demand greater than that would require modifications to the distribution network.

4.4 Existing Energy Requirements

Efforts to develop existing energy use information were based on utility company meter data. This approach provided a solid record of current conditions due to the quality of records available. For electric and steam, a minimum of one typical year of monthly data was obtained and analyzed. Monthly and annual records were also obtained for natural gas. In certain cases, estimated values based on extrapolated meter data were used in the analysis to account for unavailable information and for less than fully occupied facilities.

4.4.1 Electric Use and Conservation Practices

Annual electric use data for the existing development is contained in Table VI-14. Included in the information is the energy source used to satisfy air conditioning requirements where applicable. It is important to note that stream provides a major fraction of the existing development's energy needs to meet the air conditioning load.

TABLE VI-14

ANNUAL ELECTRIC USE FOR EXISTING DEVELOPMENT

Structure	Use Category	Area (gsf)	A/C Energy Source	Average Use (kwh/yr x 10^6)
Tower	Office	1,520,000	Steam	54.03
101 Huntington	Office	600,000	Steam	12.63
Gloucester	Residential	315,500	Electric	2.66
Boylston	Residential	305,200	Electric	2.57
Fairfield	Residential	315,200	Electric	2.66
Sheraton	Hotel	1,040,000	Steam	14.85
Comm Blocks	Retail	190,000	Electric	4.15
Lord & Taylor	Retail	135,000	Steam	2.48
Saks	Retail	122,000	Steam	2.20
Garage	Garage	1,363,000	-	6.12
TOTALS		5,905,900		104.35

The annual electric use for the existing site is approximately 104.35×10^6 kwh/yr. Peak demand for the existing complex is estimated to be 31 megawatts for a fully tenanted facility. As a result of building use, general building operation modes and energy efficiency, unit energy utilization varies with each structure. Energy efficiency is directly related to building age which reflects the improvement in energy efficiency of various structural and mechanical systems with time.

A significant effort has been made at the Prudential Center to improve the energy efficiency of existing site structures. Since 1973, a number of retrofit procedures have been incorporated to reduce the use of electrical energy. During this period annual electric consumption has been reduced by 17%. Table VI-15 lists the more important items which have contributed to the reduction in annual electric consumption.

In addition to conservation efforts, the Prudential Center operation is guided by participation in the North East Energy Cooperative. As a member of this cooperative, R.M. Bradley and Co., Inc., the Prudential Center's site management contractor, receives requests from Boston Edison to reduce electric loads during peak periods. R.M. Bradley's compliance with requests to moderate loads during peak demand have had a decidedly positive impact on Boston Edison's efforts to provide power to customers during difficult high peak periods.

4.4.2 Steam Use and Conservation Practices

Steam use for the existing development is reported in Table VI-16. Information is separated into structure and category as well as energy source for heating and cooling. All of the listed structures, which contain 4.5 million square feet of space, currently heat with steam. Steam is the energy source used for cooling 3.4 million square feet which includes all structures except the three apartment buildings.

Annual use data is reported in btu/yr and separated into cooling and heating categories. The total annual energy supplied as steam for the existing development was calculated to be 332.45×10^9 btu/yr. The peak steam demand is estimated to be 140,700 lbs/hr.

Conservation efforts have had a significant impact on steam use over the last 15 years. A number of steps have been taken to improve efficiency and reduce steam consumption. These efforts, which are listed in Table VI-17, have contributed to a net reduction in steam use of over 50%.

TABLE VI–15
CONSERVATION EFFORTS – ELECTRIC CONSUMPTION
RETROFIT ITEMS

YEAR	ITEM
1973	Reduced electric motor operating hours New Tower fans Improved HVAC systems control
1975	Shutdown of ice skating rink Reconditioned refrigeration equipment Installed chilled water piping to reduce operating hours of Top of the Hub chiller
1981	Reduced plaza lighting level
1985	Removed pumps – shutdown of fountains and moats
1986	Converted 101 Huntington main fans to variable speed Installed VAV air handling system in Prudential Tower low rise floors
1987	Installed high efficiency lamps in garage
1988	Tower lighting retrofit program

TABLE VI-16

ANNUAL STEAM USE FOR EXISTING DEVELOPMENT

Structure	Use Category	Area (gsf)	Energy Source A/C	Energy Source Heat	Annual Use-btu/yr ($x10^9$) A/C	Annual Use-btu/yr ($x10^9$) Heat	Annual Use-btu/yr ($x10^9$) Total
Tower	Office	1,520,000	Steam	Steam	15.84	58.82	74.66
101 Huntington	Office	600,000	Steam	Steam	12.75	7.45	20.20
Gloucester	Residential	315,500	Electric	Steam	–	23.93	23.93
Boylston	Residential	305,200	Electric	Steam	–	23.16	23.16
Fairfield	Residential	315,200	Electric	Steam	–	23.92	23.92
Sheraton	Hotel	1,040,000	Steam	Steam	37.00	95.26	132.26
Comm Blocks	Retail	190,000	Steam	Steam	1.98	7.34	9.32
Lord & Taylor	Retail	135,000	Steam	Steam	7.72	5.40	13.12
Saks	Retail	122,000	Steam	Steam	7.00	4.88	11.88
TOTALS		4,542,900			82.29	250.16	332.45

TABLE VI–17

CONSERVATION EFFORTS – STEAM CONSUMPTION

RETROFIT ITEMS

YEAR	ITEM
1973	Lowered thermostat settings during heating season Raised thermostat setting during cooling season Reduced outside air intake Replaced outside air dampers Lowered domestic hot water temperature Converted HVAC controls to constant volume, variable temperature for Tower and 101 Huntington Rebuilt all steam traps Rebuilt all thermostats
1975	Discontinued snow melting equipment
1976	Installed energy management computer in Tower
1977	Installed solar reflective window blinds (Tower and 101 Huntington)
1978	Extended energy management computer to garage air handlers Installed heat recovery for television station transmitters
1979	Installed solar reflective window film (Tower and 101 Huntington)
1984	Cooling tower upgraded (Tower) Installed steam condensate heat reclaimation system in Tower
1986	Converted steam chillers to high efficiency electric (Apartments)
1988	Installed new cooling towers in apartment buildings

4.4.3 Natural Gas Use

Natural gas does not play a major role as an energy source for the existing complex. Gas use is essentially limited to hotel and apartment laundries and food service/restaurant cooking and reheating.

Available meter record information was obtained for each location. Analysis and conversion of this data combined with extrapolation of information in cases where meter data was unavailable, resulted in the use levels reported in Table VI-18. The total annual use of gas is estimated to be 15×10^6 cf/yr.

4.5 New Development Energy Requirements

The energy requirements projected for the new development are based on a mix of sources. Current expectations are that the energy use strategy will be as follows:

Energy – Source	Use
Electric	Lights, mechanical equipment, and air conditioning
Steam	Heating
Gas	Laundry and cooking

4.5.1 Electric Use

Electrical energy is expected to play a somewhat larger relative role in the new development. Unlike the existing development, all new cooling requirements are anticipated to be satisfied electrically due to the energy efficiencies associated with electrical driven units versus steam. Information regarding annual electric use for the new development is contained in Table VI-19. The values for energy use shown are for all equipment including air conditioning. The annual electrical energy consumption is estimated to be 36.81×10^6 kwh/yr. This is an increase above existing useage of approximately 35%, which includes the additional reliance on electric power for air conditioning.

The reason that the increase is only 35% is because the new development will function considerably more efficiently than the existing facility, for several reasons. Today's engineering technologies and mandated building code* requirements result

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* Massachusetts State Building Code, 780 CMR.

TABLE VI–18

ANNUAL NATURAL GAS USE FOR EXISTING DEVELOPMENT

Structure	Use Category	Application	Annual Use ($cf/yr \times 10^6$)
Tower	Office	Restaurant	1.32
101 Huntington	Office	Cafeteria	2.02
Gloucester	Residential	Laundry	0.24
Boylston	Residential	Laundry	0.24
Fairfield	Residential	Laundry	0.19
Sheraton	Hotel	Laundry/Restaurant	9.04
Comm Blocks	Retail	Restaurant	1.57
Lord & Taylor	Retail	Restaurant	.50
TOTAL			15.12

TABLE VI-19

ANNUAL ELECTRIC USE FOR NEW DEVELOPMENT

ALTERNATIVE A

Use Category	Area (gsf)	A/C Energy Source	Average Use (kwh/yr x 10^6)
Office	1,009,100	Electric	21.09
Residential	404,800	Electric	6.71
Retail*	267,800	Electric	9.01
TOTALS	1,681,700		36.81

* Net new development

in significant savings in energy. Building thermal envelopes are more efficient, lighting levels are carefully controlled and reduced, and building air handling and conditioning systems are more efficient. Annualized electric use on a square foot basis, when comparing the existing Tower to new office space, is approximately 40% less with a corresponding reduction in demand. Retail and residential load performance will also be significantly improved.

Table VI-20 combines information concerning the annual electrical consumption for both the existing and new development proposed under Alternative A. Summed values (existing plus new) are given for each use category. The total for the site once all new development is completed amounts to 141.16×10^6 kwh/yr. The total peak demand calculates to 43 megawatts (31+12).

4.5.2 Steam Use

The primary application for steam in the new development is anticipated to be as a source of space heating. Table VI-21 provides data on steam consumption for the new development proposed under Alternative A. Based on the planned energy strategy and mechanical systems to be employed, the estimated steam requirements will be 50.73×10^9 btu/yr, an increase of 15% over the existing complex. Peak steam demand is expected to be 37,000 lbs/hr.

Energy conservation options incorporated into the new development will result in a very efficient utilization of purchased steam. The new Massachusetts Building Code* mandates low "U" values for walls, roofs, and glass surfaces. This requirement combined with other State Building Code energy conservation standards will lead to highly efficient use of steam for space heating.

Table VI-22 summarizes steam requirements for the existing and new development. The steam consumption values for the new facilities are relatively low compared to the existing use due to the dependence on steam for heat only. Annual steam use level for the total development is projected to be 383.27×10^9 btu/yr. The total peak demand is projected to be 177,700 lbs/hr (140,700+37,000).

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* Massachusetts State Building Code, 780 CMR.

TABLE VI–20

ANNUAL ELECTRIC USE FOR EXISTING AND NEW DEVELOPMENT

ALTERNATIVE A

(kwh/yr x 10^6)

Use Category	Existing	New	Total
Office	66.66	21.09	87.75
Residential	7.89	6.71	14.60
Hotel	14.85	--	14.85
Retail	8.83	9.01	17.84
Garage	6.12	–	6.12
TOTALS	104.35	36.81	141.16

TABLE VI–21
ANNUAL STEAM USE FOR NEW DEVELOPMENT
ALTERNATIVE A

Use Category	Area (gsf)	Energy Source A/C	Energy Source Heat	Annual Use – btu/yr (x 10^9) A/C	Annual Use – btu/yr (x 10^9) Heat	Annual Use – btu/yr (x 10^9) Total
Office	1,009,100	Electric	Steam	–	32.55	32.55
Residential	404,800	Electric	Steam	–	8.54	8.54
Retail	267,800	Electric	Steam	–	9.64	9.64
TOTALS	1,681,700				50.73	50.73

TABLE VI–22

ANNUAL STEAM USE FOR EXISTING AND NEW DEVELOPMENT

ALTERNATIVE A

(btu/yr x 10^9)

Use Category	Existing	New	Total
Office	94.86	32.55	127.41
Residential	71.10	8.54	79.64
Hotel	132.26	–	132.26
Retail	34.32	9.64	43.96
TOTALS	332.54	50.73	383.27

4.5.3 Natural Gas Use

It is currently anticipated that natural gas use will be limited to laundry and cooking although gas could be considered a potential energy source for space heating. Any new residential space will contain in-house laundry facilities, and several food services/restaurants are planned as part of the new development.

Table VI-23 reports the expected increase in gas use associated with new development proposed for Alternative A. Gas is intended for use in restaurants for food preparation and in residences for food preparation and dedicated laundries. Redevelopment is expected to increase the level of food services provided at the complex which will lead to a relative increase in gas use. The total increase required to supply the site is expected to be 9.60×10^6 cf/yr which compares favorably with the estimated available residual supply of 45×10^6 cf/yr. This change is 63% above current use. Although this is a large percentage increase, the change in gas consumption in energy units is relatively small compared to the amount of electrical and steam energy consumed.

The annual natural gas consumption requirements for the existing and proposd new development are contained in Table VI-24. The delivery system will be expected to supply a total of 24.72×10^6 cf/yr of natural gas.

4.6 Total Energy Use

In an effort to compare total energy use over time for the Prudential Center, Table VI-25 was prepared. For three points in time, annual total energy use (electric, steam, natural gas) was calculated. Nineteen seventy-three represents a use level prior to the installation of energy saving devices. The subsequent retrofits were encouraged by the oil shortages of that period. Current use levels are reported under the 1988 heading. Values in this column have been impacted by the various conservation efforts undertaken since 1973. The estimated energy use for the Prudential Center following completion of the redevelopment in 1999 is reported in the last column.

Total site energy use in 1973 was greater than it is today. Overall use today is approximately 65% of energy consumption in 1973. The proposed redevelopment will increase total energy use by about 25% over current levels. However it is important to note that the projected 1999 consumption level of 890×10^9 btu/yr is significantly less (20%) than the 1973 level of 1110×10^9 btu/yr.

TABLE VI–23
ANNUAL NATURAL GAS USE FOR NEW DEVELOPMENT
ALTERNATIVE A

Use Category	Application	Annual Use (cf/yr x 10^6)
Office	Restaurant	5.00
Residential	Laundry	0.60
Retail	Restaurant	4.00
TOTAL		9.60

TABLE VI-24

ANNUAL NATURAL GAS USE FOR EXISTING AND NEW DEVELOPMENT

ALTERNATIVE A

(cf/yr x 10^6)

Use Category	Application	Existing	New	Total
Office	Restaurant/Caf.	3.34	5.00	8.34
Residential	Laundry	0.67	0.60	1.27
Hotel	Laun/Rest	9.04	—	9.04
Retail	Restaurant	2.07	4.00	6.07
TOTALS		15.12	9.60	24.72

TABLE VI–25
TOTAL ENERGY USE INVENTORY
(btu/yr x 10^9)

Use Category	1973	1988	1999*
Office	467	326	435
Residential	175	99	131
Hotel	335	192	192
Retail	107	67	111
Garage	25	21	21
	1110	704	890

NOTE: Includes total energy from electric, steam and natural gas.

* With Alternative A in place.

4.7 Impacts and System Connections

4.7.1 Electric Service

The redevelopment, in addition to the typical uses for electricity at the existing site, will also rely more heavily on electric air conditioning. Estimates of annual electric power requirements for the new development are contained in Table VI-20 and amount to 36.81×10^6 kwh/yr.

It is not anticipated that new distribution facilities will be required in the BECO system to meet the specific requirements of the Prudential Center redevelopment. BECO has stated that they will be able to meet the needs of the proposed facility by shedding existing load from the Scotia Street substation to adjacent stations and by a new facility presently planned for the Back Bay area for implementation in the mid 1990's.

No adverse impact is anticipated in servicing facilities adjacent to the project site during construction. Electric service to existing facilities will be maintained at all times. This will be accomplished by either maintaining existing facilities in place, temporarily relocating facilities during construction, or replacing existing facilities with new facilities built in conjunction with the redevelopment.

4.7.2 Steam Service

Steam is anticipated to be used in the redevelopment for space heating. New building systems incorporated into the new structures will provide significantly more efficient use of energy. The estimated annual steam use is expected to be 50.73×10^9 btu/yr.

Steam service will be maintained to existing facilities located on site and adjacent to the project throughout construction. Service to proposed facilities will be by new service connections from the existing BTEC distribution network located in adjacent streets. New distribution systems will also be developed on site to maintain existing services and to supply the new facilities.

4.7.3 Natural Gas Service

Natural gas is expected to continue to serve the energy needs for residential laundries and food preparation. The estimate for redevelopment use is 9.6×10^6 cf/yr. Boston Gas is able to provide the increased level of service with their current system.

Gas service to existing on site facilities and adjacent facilities will be maintained throughout the redevelopment related construction. Service to proposed facilities will be supplied through new service connections to each entity from the existing Boston Gas distribution network located in adjacent streets.

4.8 System Improvements and Mitigation Measures

4.8.1 Electric Service

New service to proposed facilities will be supplied by the construction of additional electric rooms on site to create adequate capacity to meet the new loading requirements. Modifications to on-site facilities will be closely coordinated with the development implementation schedule to minimize impacts on existing services to remain. Details of proposed modifications and implementation schedules will be coordinated throughout design and construction with Boston Edison. Costs of any modifications required to either the BECO system or on-site systems will be born by the development either through direct implementation of the modification or through anticipated revenues accruing to BECO by the redevelopment with no costs to other customers.

Efforts to conserve energy will lead to reduced site needs. The institution of new State Building Code requirements for such items as lighting and insulation are expected to minimize new loads significantly. Demand limiting approaches such as ice storage for air conditioning are also being evaluated, and participation in the North East Energy Cooperative will continue. Additionally, all new structures will have emergency generators which can be used to mitigate impacts during system peak demands.

4.8.2 Steam Service

Design and construction of new facilities will be to BTEC standards and subject to their review and approval. Modifications to the steam system will be incorporated into the general redevelopment schedule to minimize potential impacts both on and off-site. The costs of proposed modifications will be born either directly by the development or by BTEC in anticipation of future revenue generated by the redevelopment.

Energy conservation procedures will have an important impact on steam use for space heating. Implementation of the applicable new State Building Code standards, which deal with building envelope features to conserve energy, will significantly moderate steam use.

4.8.3 Natural Gas Service

Based on the current energy use strategy, the existing supply system is expected to be adequate. Therefore, only local system improvements will be required. However, if the capacity of the existing natural gas distribution network is surpassed by changes in the energy supply strategy, then the system will be enhanced by the construction of new facilities or augmented facilities within the area of the site.

Modifications to the gas system will be incorporated into the general build out schedule of the redevelopment to minimize any adverse impacts on existing users and on adjacent travel ways. Costs of modifications to the gas system will be born either by the developer or indirectly by the development through anticipated increases in Boston Gas revenue.

4.9 Evaluation of Redevelopment Alternatives

Total annual energy use was calculated for each alternative and is presented in Table VI-26. Comparing the information for each alternative shows that Alternative A has the largest energy requirements. Selection of an alternative other than A will result in no significant change in the general conclusions of this report regarding the impact of the project on the energy supply systems. The chief impact of choosing a different alternative would be the changes in service connections for individual structures.

TABLE VI-26

TOTAL ANNUAL ENERGY USE

(btu/yr x 10^9)

COMPARISON OF ALTERNATIVES

Use Category	Alternative A		Alternative A2		Alternative B		Alternative B2		Alternative C		Alternative C2	
	(gsf)	(btu/yr)	(gsf)	(btu/yr)	(gsf)	(btu/yr)	(gsf)	(btu/yr)	(gsf)	(btu/yr)	(gsf)	(btu/yr
Office	1,009,100	109	1,011,100	109	865,100	93	865,100	93	811,000	88	811,000	88
Residential	404,800	32	396,300	31	378,400	30	372,800	29	324,400	26	319,600	25
Retail*	267,800	44	268,900	44	205,400	34	225,800	37	159,900	27	169,400	28
Total	1,681,700	185	1,676,300	184	1,448,900	157	1,463,700	159	1,295,300	141	1,300,000	141

* Net new space.

5.0 TELECOMMUNICATION SYSTEMS

5.1 Description of Existing Facilities

Basic telecommunication services are supplied to the Prudential Center area by the New England Telephone Company (NET) from their Back Bay Central Office (CO) facility, located on Belvidere Street between Dalton Street and Massachusetts Avenue, through a conduit and manhole network located in area streets. The existing Prudential Center is serviced through approximately nine service connections. These connections extend from individual Prudential Center entities to NET cable networks accessing the site area by way of either Belvidere Street, Dalton Street, Boylston Street and Exeter Street, or Belvidere Street and Huntington Avenue. Normal dial tone service to the Prudential Center site is generally by way of copper circuitry with fiber optic technology used for enhanced transmission services only.

5.2 Impact on Service Systems

Discussion with NET representatives indicate that the Back Bay CO has available switching capacity to accommodate the level of additional future load anticipated in its service area, including the proposed Prudential Center redevelopment. They also have determined that the existing cable, conduit, and manhole system in the Prudential Center area is in adequate physical condition and that there are no active plans to replace or rehabilitate the system. However, initial evaluation of the distribution system indicates that the conduit capacity between the CO and the Prudential site, as well as the service connections from their system to individual Prudential Center elements may be at or near capacity.

5.3 Measures to Accommodate Development

Telecommunications service to existing facilities located on-site and adjacent to the site will be maintained during project construction by either maintaining existing services in place or by replacement of the existing system with modified or new facilities.

It is anticipated that new distribution capacity will be required in the telecommunications system adjacent to the site to meet the needs of the proposed development. This will require the installation of a new duct line and manhole system between the NET Back Bay CO and the site. Construction of this system will be coordinated with the proposed site redevelopment schedule and other infrastructure improvements to minimize adverse impacts on adjacent roadways and to maintain adequate facilities for existing customers. Additional distribution systems on–site will be constructed during redevelopment to meet the needs of the new facilities.

As with the other infrastructure systems, selection of an alternative other than A will result in no significant changes to planned service system modifications. The chief impact of choosing a different alternative would be the changes in individual service connections.

All work on the telecommunications system will be performed to NET standards and will be subject to their review and approval. Costs of off–site modifications to the telecommunications system will be born by NET in anticipation of revenues from the redevelopment. Costs of on–site system modifications will be born by the development.

6.0 PROJECT PHASING

6.1 Impact on Service Systems

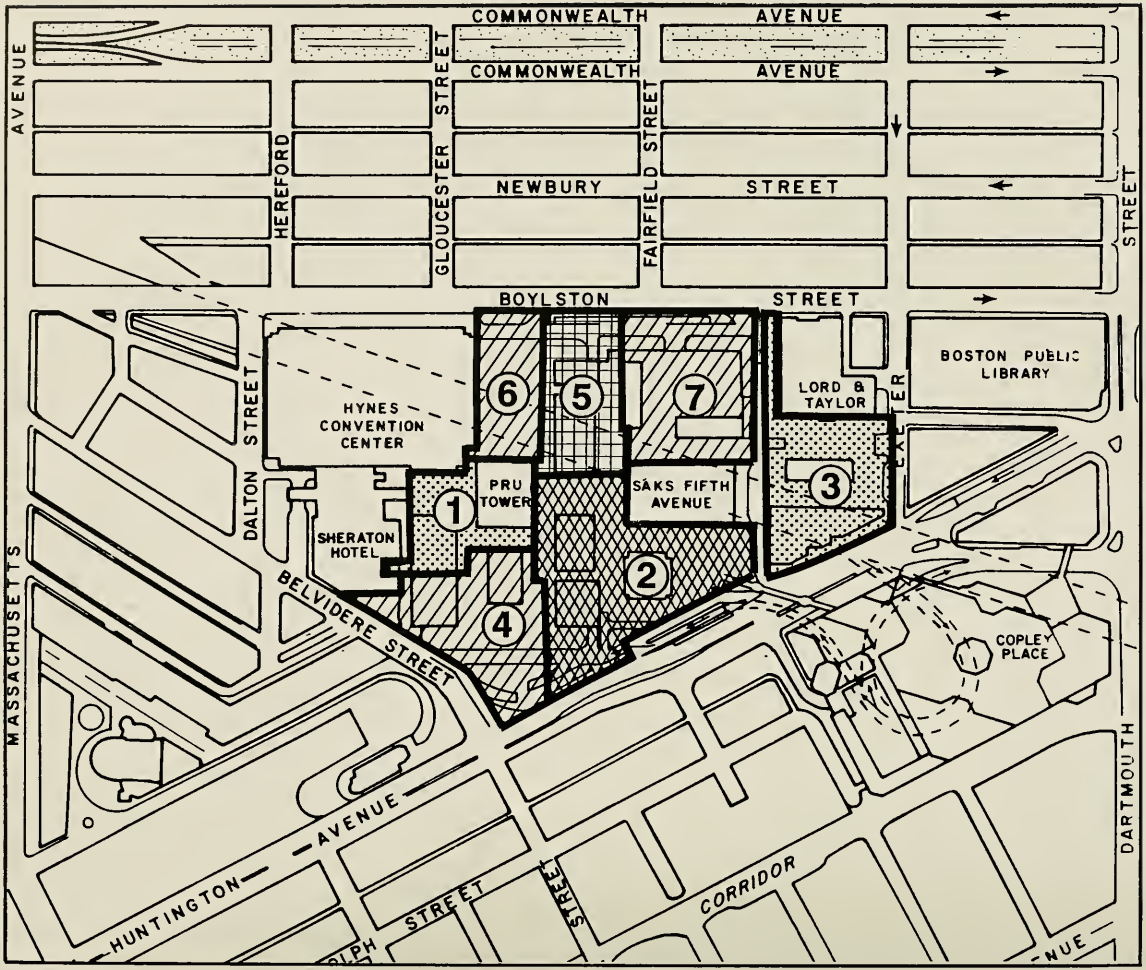
The redevelopment will take place in two stages and span a period of approximately nine years. The actual alternative selected is expected to have little impact on this schedule. The first stage of redevelopment involves an area essentially south of the Massachusetts Turnpike. The second stage of redevelopment includes the area to the north of the turnpike.

Each of the project stages has been separated into phases as shown on Figure VI–8. Project Stage I, the area south of the turnpike, contains Phases 1, 2, 3 and 4. Phases 5, 6 and 7 are included as Project Stage II to the north.

Table VI–27 was prepared to show the proportional impact of Alternative A on the various infrastructure systems of each project stage. Space categories are also incorporated into the table to show their relative impact within each stage and the project as a whole. As an example for water distribution, office space in Stage I is responsible for 85% of the total project increased water requirements for this space category. Stage II contains the remaining 15% of increased water use. There is no residential space included in Stage I and, therefore, no Stage I water demand for this category. In Stage I, retail space utilizes 60% of new retail water demand while Stage II contains the remainder. This proportioning system is typical for all other infrastructure categories contained in Table VI–27.

The totals for each infrastructure element for each project stage represent the portion of infrastructure element increased demand required for Alternative A as part of redevelopment. As an example for water, 152,050 gpd, or 57%, of the estimated water use increase will be utilized as part of Stage I. The remaining 43% is associated with build–out of Stage II. This proportioning approach is applicable to all other infrastructure elements contained in the Table.

The other development alternatives under consideration will also exert similar proportioned–over–time impacts on the infrastructure systems. Regardless of the redevelopment option chosen, it is anticipated that the project will be conducted in the two stages and seven phases described.



Prudential Center Redevelopment

Fig. VI-8
Project Phasing

Stage 1,
Phases 1,2,3,&4

Stage II
Phases 5,6,&7

0 200 400
Scale : feet

TABLE VI-27

INFRASTRUCTURE – PROJECT PHASING

ALTERNATIVE A

Stage I Years 1–5	Area (gsf)	(%)	Water (gpd)	(%)	Sewer (gpd)	(%)	Electric (kwh/yrx10^6)	(%)	Steam (btu/yrx10^9)	(%)	Gas (cf/yrx10^6)	(%)
Office	861,900	85*	120,450	85*	84,950	85*	17.93	85*	27.67	85*	4.250	85*
Residential	—	—	—	—	—	—	—	—	—	—	—	—
Retail	160,700	60*	31,600	60*	24,250	60*	5.41	60*	5.78	60*	2.400	60*
Total	1,022,600	61**	152,050	57**	109,200	53**	23.34	63**	33.45	66**	6.650	69**
Stage II Years 6–10												
Office	147,200	15*	21,250	15*	15,000	15*	3.16	15*	4.88	15*	0.750	15*
Residential	404,800	100*	73,250	100*	64,800	100*	6.71	100*	8.54	100*	0.660	100*
Retail	107,100	40*	21,050	40*	16,150	40*	3.60	40*	3.86	40*	1.600	40*
Total	659,100	39**	115,550	43**	95,950	47**	13.47	37**	17.28	34**	3.010	31**
Redevelopment Total	1,681,700		267,600		205,150		36.81		50.73		9.600	

Note: Retail is net new space.

* Percentage for total project for space category.

** Percent of redevelopment total.

6.2 Construction Impacts

Impacts on utility services will be minimized by careful project planning and the introduction of temporary service connections where appropriate. Building construction and infrastructure facility modifications will be closely coordinated with the development implementation schedule to minimize interruption of existing services. All utility companies will be informed of the details of proposed system modifications. Implementation schedules will be coordinated throughout design and construction with each of the utility groups. For additional information regarding construction impacts, see the Prudential Center Redevelopment Draft Project Impact Report/Environmental Impact Report, Volume IV, Section 6, Construction Impacts.

PRUDENTIAL CENTER REDEVELOPMENT

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Volume VII: Housing Impacts

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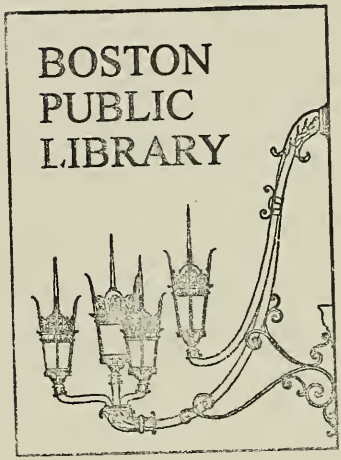
DRAFT PROJECT AND ENVIRONMENTAL IMPACT REPORT
Volume VII: Housing Impacts

VII



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submitted by:
The Prudential Property Company, Inc.
for The Prudential Insurance Company of America

Abt Associates
Langley Keyes

DRAFT PROJECT AND ENVIRONMENTAL IMPACT REPORT

PROJECT

Prudential Center Redevelopment
Boston, Massachusetts

DEVELOPER

The Prudential Property Company, Inc., for The Prudential Insurance Company of America

STATUS OF PROJECT

The developer submitted a Project Notification Form to the Boston Redevelopment Authority (BRA) and an Environmental Notification Form to the Massachusetts Executive Office of Environmental Affairs (EOEA) on June 29, 1988. Scoping letters were issued to the developer by the BRA and EOEA on September 1, 1988. The EOEA number is 7208. The project is in pre-schematic design stage. Master plan approval is being sought.

BRIEF DESCRIPTION OF THE PROJECT

The project proposes the addition of new offices, retail spaces and housing to the current Prudential Center site. New housing and offices, with retail uses at their base, will be constructed principally along the Boylston Street, Huntington Avenue and Belvidere Street frontages. The current retail area will be reconstructed and expanded on a single level with indoor pedestrian passageways. Enclosed pedestrian routes will provide connections between Boylston Street and Huntington Avenue, and between Copley Place and the south entrance of the Hynes Convention Center. A system of public squares, a wintergarden and outdoor open spaces will be amenities for those using the center and adjacent neighbors. A neighborhood commercial area, including an expanded supermarket, is proposed for Huntington Avenue and East Ring Road will be improved to facilitate pedestrian flows at street level to the shopping area. The existing parking garages will remain approximately the same size, but their capacity will be expanded by approximately 800 spaces through changes to their management.

ALTERNATIVES CONSIDERED

Two basic planning approaches have been considered for the site, and for each three scales of building program have been analyzed. Alternative A proposes two new office structures along Huntington and principally housing, with a small office structure, along Boylston. Alternative A2 has housing as well as offices along Huntington and housing, along with expanded offices, along Boylston. The form of structures, their heights, and the organization of pedestrian routes also vary between these two basic alternatives. Alternatives B and B2 are similar in configuration, respectively, to Alternatives A and A2, but the overall development totals 10 percent less area. Alternatives C and C2 follow the same outlines, but are 20 percent smaller in area than Alternatives A and A2. In the course of preparing these plans, a large number of other design and functional alternatives were considered and rejected as less desirable.

DEVELOPMENT PROGRAM

The three basic levels of program studied are, as follows:
(000 FAR gross sq. ft.)

Use	Alternatives A and A2	Alternatives B and B2	Alternatives C and C2
Offices	1,009	865	811
Residential	404	378	324
Retail	268*	210*	160*
Total Areas	**1,681**	**1,448**	**1,295**
Plus Indoor Pedestrian Areas	153**	153**	103**
TOTAL PROGRAM	**1,834**	**1,601**	**1,398**

* In addition, 143,000 gross sq. ft. of existing retail is demolished and rebuilt.

** Areas vary slightly between alternatives.

DEVELOPMENT SCHEDULE

The project is planned as a number of separate phases to be completed over a 10 year period. Construction will begin on the south side of the site, moving to the north. Phases along Huntington Avenue should be completed by 1994, with the Boylston Street area completed by 1999.

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IIIA: Transportation Access Plan Appendix
IV: Environmental Impacts
V: Wind Impacts
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PRUDENTIAL CENTER REDEVELOPMENT

DRAFT PROJECT AND ENVIRONMENTAL IMPACT REPORT
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COMPREHENSIVE HOUSING IMPACT REPORT FOR THE PRUDENTIAL CENTER REDEVELOPMENT

1.0 SUMMARY

In response to the requirements of the Project Notification Form for the proposed Prudential Center redevelopment, Prudential Properties sponsored this comprehensive housing impact study under the guidance and review of the Housing Subcommittee of the Prudential Project Advisory Committee (PruPAC).

This study undertakes to estimate marginal impacts on housing costs--those incremental effects attributable to the Prudential Center Redevelopment. These estimated marginal cost effects are in addition to the underlying housing cost trends in the impact areas. Two primary sources of marginal housing impacts were estimated--employment-related impacts and induced housing demand impacts. Employment-related impacts result from inmigrants who move into the city for jobs related to the newly redeveloped Prudential Center. Induced housing demand impacts refer to inmigrants who move into the impact area because the new Prudential Center has made it a more desirable place to live, for reasons unrelated to employment (for example, added cultural opportunities).

1.1 Employment-Related Impact

The model for estimating employment-related demand starts with the number of additional square feet planned for office and retail space in the Prudential Center Redevelopment. Based on industry norms for the number of square feet per employee, we estimate the number of employees expected to work in the new space. This number of employees is reduced by an estimate of the offsetting number of employees expected simply to shift from other Boston jobs and is increased by new employment generated by the additional business created by the tenant firms and employees of the new Prudential Center space. A 1987 survey of Prudential Center employees provides an estimate of the fraction of these new employees expected to reside in Boston. Applying the survey results to the planned mix of uses in the Prudential Center expansion, we estimate that 31 percent of total net new employees would be Boston residents--7.2 percent in the impact area neighborhoods adjoining the Prudential Center. To arrive at the estimated net number of new employees expected to move into Boston, the number of Boston-resident employees is reduced by estimates of the number that were previously Boston residents and were unemployed, not in the work force, or working outside of Boston. Employees are related to households by estimating the typical number of workers per

household. The 1987 survey of Prudential Center employees provides our estimates of choice of residence location within Boston for inmigrating employees. The distribution of new employees in the short and long term may differ from the choices of current employees due to changing tastes and economics. However, current employees provide the best available estimate of which areas of Boston these households will choose for a residence.

The degree of pressure that these additional households seeking a place to live put on the housing available in the areas where they are expected to try to locate is indicated by the ratio of additional households looking in each area to the housing available in that same area. Available housing is computed by using Boston Redevelopment Authority (BRA) statistics on the number of housing units in each neighborhood and the additional housing stock expected to be added by 1994--the planned beginning of phase-in of the Prudential Center Redevelopment--and assuming that this stock turns over or changes hands at the same rate as currently observed and recorded in BRA data. Units are added to the available stock of rental and owner units from 1995-1998 through new construction, vacancy decontrol and conversions from rental units to condominiums. We assume that in the case of rentals, all of the incremental demand from the Prudential Center Redevelopment is concentrated on market rentals and vacancy decontrol units; we assume that rent controlled and subsidized units are not available.

From housing economics research we then calculate the expected marginal increases in housing costs that would be attributable to the calculated increases in demand--additional households looking as a fraction of the housing available at turnover. The results of the study indicate that in the first year of the project, rents on units turning over in the impact area would rise by 0.5 percent and prices by 0.4 percent. Over the five-year period when the Prudential Center Redevelopment is to come onstream, 1994 through 1998, employment-related demand in the impact area would cause an estimated incremental increase of 2.7 percent in rents and an estimated incremental increase of 1.6 percent in ownership housing prices. While the estimated increases are only for units changing hands, rents and prices on other units may be impacted over time, though to a lesser extent.

The neighborhood-by-neighborhood estimates of employment-related housing demand impacts are shown in Table 1-1. While the impacts reflect average increases for all units changing hands in the neighborhoods, specific properties or areas within neighborhoods may experience stronger or weaker impacts. For example, if more inmigrants than expected move into the Fenway neighborhood, the five year impacts could be higher

than those estimated below. In that case, other areas would experience smaller increases in demand.

TABLE 1-1

Neighborhood Impacts

Neighborhood	Expected Rent Increase in 1994	Total 5 Year Rent Increase	Expected Price Increase in 1994	Total 5 Year Price Increase
Back Bay, Beacon Hill	0.6%	3.1%	0.4%	2.0%
South End	0.5%	2.4%	0.3%	1.2%
Fenway, Kenmore	0.5%	2.6%	0.3%	1.6%
Lower Roxbury, Mission Hill	0.2%	1.1%	0.2%	0.9%
Total Impact Area	0.5%	2.7%	0.4%	1.6%
Rest of Boston	0.6%	2.9%	0.4%	1.6%
Total Boston	0.6%	2.8%	0.4%	1.6%

Based on locations of current employees working in Prudential Center, we would expect similar ranges of impacts in some Boston neighborhoods outside the impact area. Also, the relocation of the Orange Line of the Massachusetts Bay Transit Authority and the subway stations now available at Back Bay and Roxbury Crossing would be expected to shift some of the employment-related demand to neighborhoods located along this subway line.

1.2 Induced Housing Demand

Induced housing demand refers to the marginal increase in demand for housing in the vicinity of point of change purely because of a positive change in the perceived attractiveness of living near the point of change, the Prudential Center in this case. Induced demand is difficult to estimate, both because judgements are highly subjective about how much the attractiveness of living near the Prudential Center will change as a result of the redevelopment and because influences on price changes are difficult to sort out. In an attempt to obtain a reference estimate of induced demand, we have examined condominium price trends in the immediate environs of the Copley Place development. These prices are, of course, affected not only by the increased attractiveness of the location but also by Copley Place's employment-related housing demand pressures, the

opening of the new Back Bay station of the relocated Orange Line and other local factors. If we make the extreme assumptions that the Prudential Center Redevelopment will change the attractiveness of the Prudential Center in exactly the same way that the Copley Place development altered the residential attractiveness of its environs, and that all of the price increases observed in condominium prices for units located on streets adjacent to Copley Place relative to the rest of Back Bay and South End are purely because of induced housing demand from Copley Place, existing data suggest that this effect could increase condominium prices by 2.6 percent above the overall Back Bay-South End price trend. Under what we believe are more plausible assumptions--that the Prudential Center Redevelopment will increase the attractiveness of its area by no more than 20 percent of the Copley Place change (and that no more than half of the observed differential price increase in the area around Copley Place is attributable to induced demand as distinct from underlying price trends, Copley Place employment-related housing impacts, or other contemporary developments such as the opening of the relocated Orange Line of the subway with a new station at Back Bay)—we would conclude that the maximum likely impact from induced housing demand of the Prudential Center Redevelopment would be less than one percent in the few adjacent blocks. Whatever the level of impact of induced demand on housing prices, it is in addition to the employment-related impacts.

We do not have an empirical basis for estimating what the effects of induced housing demand might be on rents. Our judgement is that while effects on rental prices will exist they would be less than on condos, primarily because the life-style character of induced demand is more likely to be important at the upper end of the housing market which condominiums serve than for rental housing.

Our estimates include assumptions that the continuing process of vacancy decontrol of rent-controlled housing will substantially deplete the current rent-controlled stock and that the rate of condominium conversion will slow, both because of market saturation and because of the June 1988 amendments to Boston ordinances restricting permits to remove rental housing and placing limitations on condominium/cooperative conversion.

We conclude that employment-generated rent and price impacts will be quite dispersed throughout the Boston metropolitan area, with little concentration in the impact area and with resulting marginal increases in rents and prices of well under one percent annually for units changing hands. Further, to the extent that we can use the price trends around the Copley Place development as a reference, the induced demand

resulting from the increased attractiveness of the Prudential Center redevelopment would increase prices in adjoining blocks by less than one percent. Even when a wide range of variation is made in the assumptions used in the impact calculations, the basic observation is that the predicted impacts are quite dispersed and the annual impacts in prices and rents in the impact area around the Prudential Center are predicted to be on the order of one percent or less, for example, on the order of $5 a month or less for apartments renting in the $500 a month range.

These predicted annual impacts are so small that we would expect no discernable displacement of current residents to result from these impacts. Although we expect no displacement to result from the marginal effects of the Prudential Center redevelopment, rent and price increases attributable to other factors in the Boston housing market may well continue to displace some residents of the impact area.

2.0 ESTIMATES OF EMPLOYEE RELATED DEMAND

The housing impact study focuses on a set of neighborhoods identified by the Housing Subcommittee of the PruPAC as the impact area and estimates both employment-related demand and induced housing demand. This section outlines the rationale for selection of the impact neighborhoods and describes the model used to estimate employment-related housing demand likely to be generated by the Prudential Center Redevelopment.

2.1 Impact Area

The Housing Subcommittee of the PruPAC identified particular neighborhoods of concern in terms of market impact. These were:

Pru Center Apartments
Fenway
Back Bay
Bay Village
South End
St. Botolph Street
Lower Roxbury
Kenmore Square
Mission Hill
Audubon Circle

These areas are inclusive of the neighborhoods bordering on the current Prudential Center and a next rung of neighborhoods away from downtown Boston and represent a plausible set of neighborhoods of primary concern. They do not, of course, represent all of the areas of possible housing impacts from the planned Prudential Center Redevelopment, because these impacts will be felt in other areas in the City of Boston where employees in the newly created space might seek housing, as well as in the rest of the Boston area housing market. Our analysis has focused particularly on the impact area, has provided reference impact figures for the balance of Boston, and has simply indicated the magnitude of the remaining demand that would lie outside of Boston.

To define neighborhoods within the impact area that are large enough for separate estimates and for which housing stock data are available from the Boston Redevelopment Authority, we chose the following regrouping of the neighborhoods in the impact area:

Back Bay and Bay Village

BRA Neighborhood Statistical Area (NSA) 4 and half of NSA 7; includes the Boston Common side of Beacon Hill; coincides essentially with zipcode 02199, 02116 plus 02108 and portions of 02114 and 02115;

East Fens and the Medical Area

NSAs 27 and 45; most of zipcode 02115;

Kenmore/West Fens

NSAs 28 and 29; zipcode 02215;

Mission Hill/Lower Roxbury

NSAs 46, 47, and half of 53; coincides essentially with zipcode 02120;

South End

NSA 61; coincides essentially with zipcode 02118.

Exhibit 2-1 displays the impact area neighborhoods and the associated zip codes.

2.2 Employment-Related Demand

For employment-related demand, we have used an employment generation model and model parameters closely parallel to those used by consultant Philip Herr and Associates (draft report for Project Notification Form, April 15, 1988) in estimating employment impacts of the Prudential Center Redevelopment.[1] Employment generation is estimated in two parts:

- direct employment, or the new employees working in the additional office and retail space,
- indirect employment, or the jobs generated outside of the Prudential Center but related to the redevelopment.

Table 2-1 summarizes the model results, beginning with the planned number of square feet of new office and retail space and ending with the estimated number of new employees moving into Boston as a result of the Prudential Center Redevelopment.

Based on industry norms for the number of square feet per employee, we estimate the number of employees expected to work in the new space. We have used 213 square feet per employee in retail space, according to Philip Herr and Associates.[2]

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[1]For details on Philip Herr's model and assumptions, which are based on the available literature and empirical evidence, see, "Evaluating Development Impacts," Philip B. Herr & Associates, February 1988.

[2]The office figure is well within the range of average square footages per employee indicated in the "Boston Office Industry Survey, 1986" developed by the Boston Redevelopment Authority. Cambridge Systematics has used a figure of 233 square feet per office employee in its work. The retail area per employee of 306 compares with 400 square feet per employee used by Cambridge Systematics. The Copley Place impact study developed in 1979 by Economics Research Associates used 208 square feet per office employee and 326 square feet per retail employee. Using a larger number for the typical square footage per employee in retail space would reduce the estimated number of employees and the resulting estimated marginal impact.

EXHIBIT 2-1

Impact Area Neighborhoods and Zip Codes

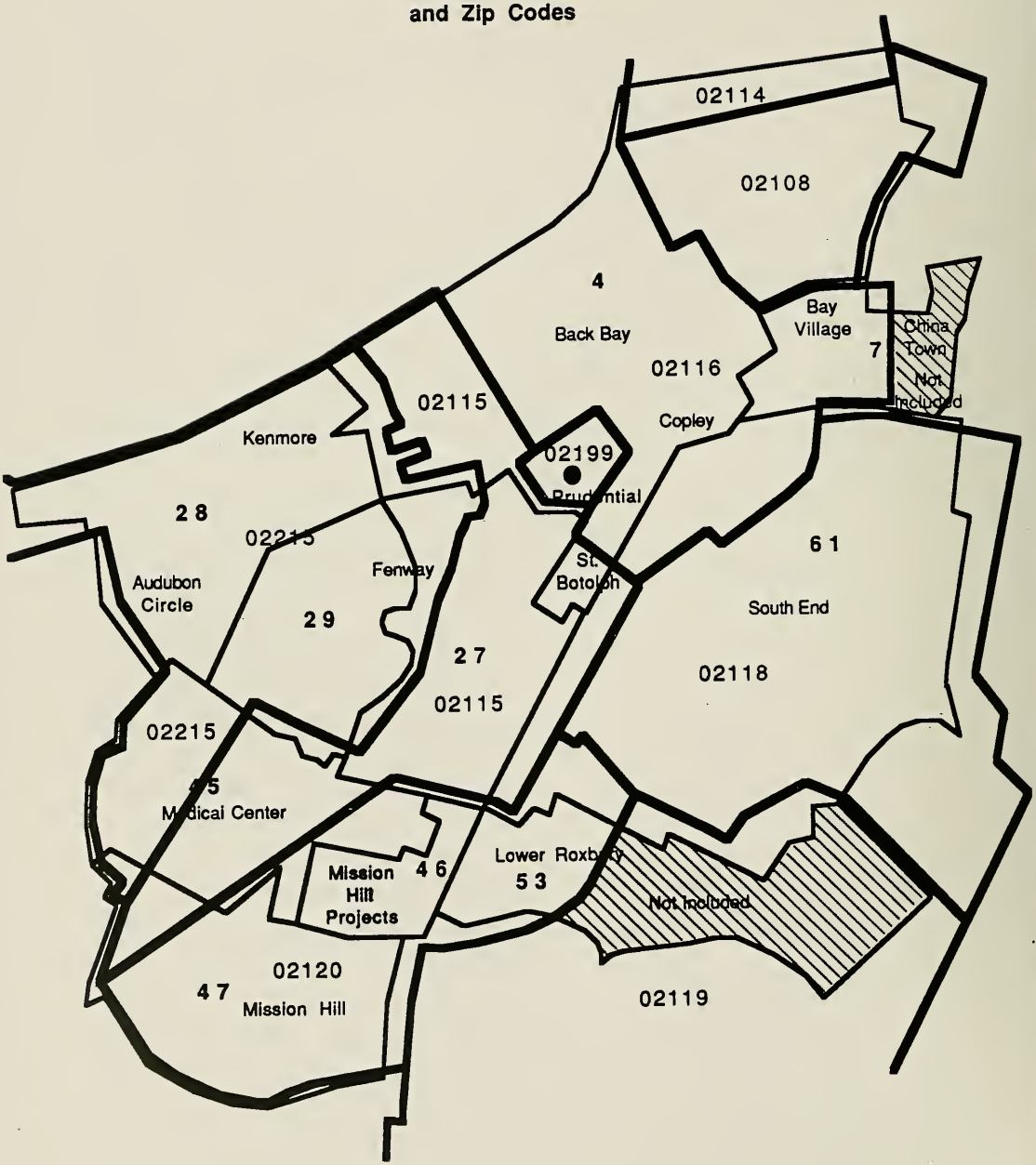

TABLE 2-1

PRUDENTIAL REDEVELOPMENT HOUSING IMPACT ESTIMATES: EMPLOYMENT-RELATED DEMAND

	OFFICE	RETAIL	HOUSING	TOTAL	SOURCE
GROSS RENTABLE AREA (SF)	935,000	241,000	372,000	1,548,000	PROJECT NOTIFICATION FORM
AREA/EMPLOYEE	213	306			PHIL HERR, "PNF REPORT FRAGMENTS,"
ON-SITE NEW EMPLOYEES	4,390	788		5,177	APRIL 15, 1988
DISPLACEMENT JOBS FACTOR	0.100	0.400			PHIL HERR
DISPLACEMENT JOBS	439	315		754	
NET JOBS ADDED	3,951	472		4,423	
INDIRECT EMPLOYMENT GENERATION:					
BUSINESS PURCHASE JOBS FACTOR	0.180	0.101			HERR
BUSINESS PURCHASE JOBS	711	48		759	
EMPLOYEE PURCHASE JOBS FACTOR	0.050	0.050			HERR
EMPLOYEE PURCHASE JOBS	197	24		221	
ATTRACTED JOBS (AGGLOMERATION) FCTR	0.100	0.100			HERR
ATTRACTED JOBS	395	47		442	
TOTAL JOBS GENERATED	5,254	591		5,845	
FRACTION BOSTON RESIDENTS	0.213	0.422		0.309	CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY
NUMBER BOSTON RESIDENT JOBS	1,118	249		1,367	
JOBS OF PREVIOUSLY UNEMPLOYED FACTOR	0.064	0.087			HERR
JOBS OF PREVIOUSLY UNEMPLOYED	72	22		94	
ADDED WORKERS NOT PREVIOUSLY IN LABOR FORCE, FACTOR	0.064	0.101			HERR
ADDED WORKERS NOT PREVIOUSLY IN LABOR FORCE	72	25		97	
FORMER OUTCOMMUTER FACTOR	0.234	0.215			HERR
FORMER OUTCOMMUTERS	261	53		315	
NET BOSTON IMMIGRANT EMPLOYEES	713	149		862	

Dividing square footage by the estimated area per employee yields the estimated number of employees, labeled "On-site New Employees." Because some of the commercial activity in the additional Prudential Center space will represent transfers from activity that simply would have located elsewhere in Boston, this is taken into account by an estimated "Displacement Jobs Factor," indicating the estimated fraction of new employees that are displacement jobs. We estimate that only 10 percent of the office jobs will be such displacement jobs, while 40 percent of the retail jobs will be.[3] The difference between On-site New Employees and Displacement Jobs is the Net Jobs Added.

Net Jobs Added by the new space in the Prudential Center Redevelopment is increased by new employment generated by the additional business created by the new Prudential Center space. This indirect employment is estimated in three pieces:

- Business Purchase Jobs--Boston jobs generated by the commercial activity involved in supplying the goods and services purchased by the businesses in the new Prudential Center space,
- Employee Purchase Jobs--additional Boston jobs generated to provide things like lunches and retail goods to employees working in the new Prudential Center space,
- Attracted Jobs--jobs generated by businesses locating in the Prudential Center area just because it is the place to be, where similar firms are operating and customers know to come.

Business Purchase Jobs are estimated through the "Business Purchase Jobs Factor" from Philip Herr and Associates--18 percent of Net Jobs Added by the office space and roughly 10 percent of Net Jobs Added by the retail space. Employee Purchase Jobs are estimated by the Employee Purchase Jobs Factor of 5 percent of Net Jobs Added (also from Philip Herr and Associates). Attracted Jobs are assumed to be 10 percent of Net Jobs Added (also from Philip Herr and Associates).

Starting from Net Jobs Added (directly by the Prudential Center Redevelopment) we add Business Purchase Jobs, Employee Purchase Jobs and Attracted Jobs to arrive at Total Jobs Generated. Now begins the task of estimating locations of these employees.

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[3]Philip Herr and Associates assumed no displacement jobs for the office space but also assumed 40 percent displacement jobs for the retail space.

For estimates of the residential locations likely to be chosen by employees related to the Prudential Center Redevelopment, we have used the locations of the residences of employees in the current Prudential Center, as compiled in a survey performed for the project in 1987 by Cambridge Systematics.[4] From the Cambridge Systematics 1987 survey, 21.3 percent of office employees resided in the City of Boston as did 42.1 percent of retail employees. These are typical of numbers reached in other studies of employment impact.[5] We have used these figures to estimate the overall Number of Boston Resident Jobs. Taking into account jobs which will be filled by current

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[4]Original survey results were reported in "Profile of Existing Transportation Conditions in the Back Bay", prepared for the Prudential Realty Group by HMM Associates, Inc. and Cambridge Systematics, Inc., September 1987. Cambridge Systematics provided us with a tape of the original survey data, on which were recorded the zipcodes of respondents as well as whether the firm for which they worked was office or retail space. Because Prudential Properties judged that Boston Edison would not represent well the types of employees to be expected of newer firms leasing the additional space, we excluded Boston Edison from the location data. Boston Edison represented 35.6 percent of the employee sample; 26 percent of Boston Edison employees lived in Boston compared with 21.3 percent of other office workers; of the Boston residents 13.4 percent of Boston Edison employees lived in the impact area compared with 26.2 percent of other office workers. Thus, inclusion of the Boston Edison employees to estimate locational patterns would primarily shift some of the Boston impact out of the impact area.

[5]The April 15, 1988 report of Philip Herr and Associates estimated that 27 percent of office employees and 48 percent of retail employees would be Boston residents. Kayden, Case, and Pollard, in "The Linkage Between Office Development and Housing Costs in the City of Boston", prepared for the BRA in January 1986, reported results of surveys with 1207 employees of recently built Boston office buildings, indicating that 22.2 percent of the respondents lived in Boston. Only 7 percent said that their office building job was "a major reason" for their move to Boston. In their October 1979 report to the BRA, "Residential Property Value and Rent Impact Analysis for Copley Place Development", Economics Research Associates tabulated the following results of relevant surveys on employee locations:

- "John Hancock Life Insurance Company--based upon 5,700 home office employees, 31% live in the City of Boston.
- Christian Science Center--based upon 1,400 employees, approximately one-third live within walking distance, ride bikes or use local buses. It is estimated that 25% of these living locally are professional/management workers who live in luxury high rises such as the Prudential Apartments or Church Park. The remaining 75% are younger, generally unmarried, live in walk-up apartments and typically have roommates.
- Prudential Tower and Prudential Plaza--the BRA study of these facilities in 1970 indicated that 29% of the Prudential Tower employees (primarily service industry) lived within walking distance of their office. For Prudential Plaza, 41% of the employees lived within walking distance."

Boston residents who will have no impact on housing demand, three corrections to this figure are made, using factors from the employment work by Philip Herr and Associates:

- Jobs of Previously Unemployed--estimating Boston residents in the labor force but unemployed that take up jobs as a result of the Prudential Center Redevelopment;
- Added Workers Not Previously in the Labor Force--estimating Boston residents that had not previously been in the labor force, that is, not registered as looking for a job, who take up jobs as a result of the Prudential Center Redevelopment;
- Former Outcommuters--to account for those who switch jobs from a business outside of Boston to one related to the Prudential Center Redevelopment.

With these three subtractions from Total Jobs Generated we have Net Boston Inmigrant Employees as our best estimate of the number of employees related to the Prudential Center Redevelopment who will move into Boston.

As our best source for estimating preferred locations of these Boston Inmigrant Employees, we have used the zipcode information from the 1987 Cambridge Systematics Survey of employees in the current Prudential Center. Table 2-2 displays the fractions of total employees--separately for those related to the office space and for those related to the retail space--expected to locate in the impact area neighborhoods within Boston, in the rest of the City of Boston, or outside of the City of Boston. As the headings indicate, we have allocated employees from zipcode 02115—one fourth to Back Bay and three-fourths to the East Fenway/Medical Center area. We also allocated zipcode 02114--half to Back Bay/Beacon Hill and half to the rest of the City of Boston. The table shows that of current Prudential employees, 21 percent of office workers and 42 percent of retail workers live in Boston. Only 5.6 percent of office workers and 21.1 percent of retail workers reside in the impact area. For the planned mix of office and retail in the Prudential Center expansion, this would suggest that 7.2 percent would live in the impact area [(.056 x 5254 + .214 x 541) ÷ 5845].

Table 2-3 shows the distribution of occupations by employer type and Table 2-4 displays residence location by occupation. Thirty-six percent of employees in sales and service positions as well as clerical positions live in Boston. However, 20 percent of sales employees live in the impact area compared with 5 percent of the clerical workers. Only 17 percent of executives and professionals live in Boston.

One of the current Prudential Center tenants, Boston Edison, was able to provide income data for their employees. Table 2-5 shows that pattern for Boston Edison employees who live outside Boston tend to be in higher income categories (executive/pro-

TABLE 2-2

ESTIMATED DISTRIBUTIONS OF IMMIGRANT EMPLOYEES AND HOUSEHOLDS

	IMPACT AREAS (BY ZIPCODE ASSOCIATIONS)									
	BACK BAY 02108	KENMORE W. FENS	MEDCTR E. FENS	ROXBURY Xing	SOUTH END	IMPACT AREA	REST OF BOSTON	TOTAL BOSTON	OUTSIDE BOSTON	TOTAL
ZIPCODES	02116,99 1/2 02114 1/4 02115	02215	3/4 OF 02115	02120	02118		02101-13 1/2 02114 19-37,02210		ALL OTHER ZIPCODES	
OFFICE:										
FRACTION OF TOTAL EMPL.*	0.0316	0.0049	0.0103	0.0020	0.0069	0.0557	0.1571	0.2128	0.7851	0.9979
BOSTON FRACTION, TOT EMPL.	0.1485	0.0230	0.0484	0.0094	0.0324	0.2617	0.7383	1.0000		
BOSTON IMMIGRANT EMPLOYEES	106	16	35	7	23	187	526	713		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
IMMIGRANT RENTER EMPLOYEES	66	13	27	4	14	124	311	435		
RENTER EMPLOYEES/HOUSEHOLD	1.3	1.3	1.3	1.3	1.3			1.3		
BOSTON RENTER HOUSEHOLDS	50	10	21	3	11	96	239	334		
IMMIGRANT OWNER EMPLOYEES	40	4	8	2	9	62	216	278		
OWNER EMPLOYEES/HOUSEHOLD	1.05	1.05	1.05	1.05	1.05			1.05		
BOSTON OWNER HOUSEHOLDS	38	3	7	2	8	59	205	265		
RETAIL:										
FRACTION OF TOTAL EMPL.*	0.0937	0.0187	0.0491	0.0093	0.0405	0.2113	0.2102	0.4215	0.5794	1.0009
BOSTON FRACTION, TOT EMPL.	0.2223	0.0444	0.1165	0.0221	0.0961	0.5013	0.4987	1.0000		
BOSTON IMMIGRANT EMPLOYEES	33	7	17	3	14	75	74	149		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
IMMIGRANT RENTER EMPLOYEES	21	5	14	2	9	50	41	91		
RENTER EMPLOYEES/HOUSEHOLD	1.40	1.40	1.40	1.40	1.40			1.40		
BOSTON RENTER HOUSEHOLDS	15	4	10	2	6	36	29	65		
IMMIGRANT OWNER EMPLOYEES	13	1	4	1	5	24	34	58		
OWNER EMPLOYEES/HOUSEHOLD	1.25	1.25	1.25	1.25	1.25			1.25		
BOSTON OWNER HOUSEHOLDS	10	1	3	1	4	19	27	46		

*FRACTIONS OF TOTAL EMPLOYMENT FROM CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY

Table 2-3

DISTRIBUTION OF OCCUPATIONS BY EMPLOYER TYPE

EMPLOYER	OCCUPATION					
	Sales or Service	Clerical/ Office	Executive/ Professional	Crafts or Other	Total*	N
Boston Edison	5%	42%	51%	3%	100%	767
Other Office	6%	40%	52%	2%	100%	1007
Retail	41%	17%	36%	6%	100%	309
Sheraton	75%	6%	10%	10%	100%	52

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* Sum of individual percentages may not equal 100 due to rounding.

Data Source: Cambridge Systematics 1987 Survey of Prudential Center Employees

Table 2-4

RESIDENCE LOCATIONS BY OCCUPATION

Area	Zipcode	Sales or Service	Clerical/ Office	Executive/ Professional	Crafts or Other
Back Bay	02116	8%	1%	2%	3%
BU/Kenmore	02215	2%	1%	*	0%
Charles	02114	1%	0%	1%	0%
Fenway	02115	5%	1%	1%	5%
Roxbury Crossing	02120	2%	1%	*	0%
South End	02118	2%	1%	1%	0%
Other Boston	-	17%	31%	11%	20%
Outside Boston	-	64%	64%	83%	72%
Total**	-	100%	100%	100%	100%
N	-	264	775	1031	65

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* Indicates less than 0.5%.

** Sum of individual percentages may not equal 100 due to rounding.

Data Source: Cambridge Systematics 1987 Survey of Prudential Center Employees

Table 2-5: Salary Distribution of Boston Edison Prudential Center Employees by Residence Location

	RESIDE IN BOSTON			RESIDE OUTSIDE BOSTON		
SALARY RANGE	COUNT	PERCENTAGE	CUMULATIVE PERCENTAGE	COUNT	PERCENTAGE	CUMULATIVE PERCENTAGE
10,000-15,000	1	0.24%	0.24%		0.00%	0.00%
15,000-20,000	31	7.54%	7.79%	17	1.83%	1.83%
20,000-25,000	65	15.82%	23.60%	44	4.73%	6.55%
25,000-30,000	144	35.04%	58.64%MED.	98	10.53%	17.08%
30,000-35,000	70	17.03%	75.67%	110	11.82%	28.89%
35,000-40,000	35	8.52%	84.18%	118	12.67%	41.57%
40,000-45,000	17	4.14%	88.32%	112	12.03%	53.60%MEDIAN
45,000-50,000	19	4.62%	92.94%	132	14.18%	67.78%
50,000-55,000	11	2.68%	95.62%	100	10.74%	78.52%
55,000-60,000	6	1.46%	97.08%	61	6.55%	85.07%
60,000-65,000	3	0.73%	97.81%	49	5.26%	90.33%
65,000-70,000	3	0.73%	98.54%	30	3.22%	93.56%
70,000-75,000	2	0.49%	99.03%	23	2.47%	96.03%
75,000-80,000	1	0.24%	99.27%	11	1.18%	97.21%
80,000-85,000		0.00%	99.27%	5	0.54%	97.74%
85,000-90,000		0.00%	99.27%	6	0.64%	98.39%
90,000-95,000		0.00%	99.27%	3	0.32%	98.71%
95,000-100,000		0.00%	99.27%	3	0.32%	99.03%
OVER 100,000	3	0.73%	100.00%	9	0.97%	100.00%
TOTAL	411	100.00%		931	100.00%	

Data Source: Boston Edison

fessional positions) than those living in the city. This is consistent with the employee occupation mix indicated in Table 2-3 and the location by occupation shown in Table 2-4.

To estimate the tenure choice of the employees in each of the impact area neighborhoods, we have allocated them as renters or owners in the same proportions as the available stock in each neighborhood. The survey of current employees did not include tenure, so we assumed that new residents would distribute in a manner similar to current neighborhood households. Any other action would drive up prices in places where they were disproportionately placed. Data on available stock were obtained for us by consultant Rolf Goetze, who developed neighborhood-level housing stock data consistent with the Planning District data developed by the Boston Redevelopment Authority.

To relate employees to households, we had to make some judgements about the extent to which the employees moving into Boston would be likely to be in households with other employed persons versus taking an entire housing unit, whether as a single person or as a family having only one employed member. Overall, in the City of Boston the average number of workers per household is 1.4. For this study on employee impacts we have a lower bound of one worker per household; that is, we start with an employee related to the Prudential Center Redevelopment and consider at least that person and any related household members come into Boston. At the other extreme, it would be possible to have four or five workers sharing a single housing unit. We assume from other demographic data on Boston that lower income workers are more likely to rent and to have to double up, or share a housing unit with other workers. We have therefore estimated the number of employees per household for owners and renters among inmigrant office workers and retail workers as follows:

	Office Workers	Retail Workers
Renter Employees/Household	1.3	1.4
Owner Employees/Household	1.05	1.25

While we lack data on the household composition and incomes of even current Prudential Center employees, this pattern seems a plausible one based on existing data on household demographics (from sources such as the 1981 Annual Housing Survey for the Boston metropolitan area, conducted by the U.S. Census for the U.S. Department of Housing and Urban Development).

With these assumptions on the relationship between number of employees seeking housing and the number of workers per household, we have estimated the numbers of households expected to demand rental housing or to seek a place to buy, within each of

the impact area neighborhoods, as shown at the bottom of Table 2-2. This constitutes the estimated increase in housing demand generated by the employment related to the planned Prudential Center Redevelopment to be used in the impact estimates of Section 4.0.

3.0 HOUSING SUPPLY

3.1 1987 Housing Stock

Housing supply figures are based on 1987 Boston Redevelopment Authority housing stock estimates for the city as a whole and for neighborhoods in the impact area. We retained consultant Rolf Goetze to develop neighborhood level stock estimates using the same data as the BRA's Planning District Profiles. The impact areas for the 1987 housing stock are defined as follows:

- Back Bay, Beacon Hill and Bay Village, which includes Neighborhood 4 (Back Bay, Beacon Hill) and half of Neighborhood 7 (Bay Village/Chinatown). Zipcodes for this area are 02108, 02116, 02199, 1/2 of 02114 and 1/4 of 02115.
- South End includes Neighborhood 61, zipcode 02118.
- Kenmore, West Fenway includes Neighborhoods 28 and 29, zipcode 02215.
- East Fenway, Medical Center includes Neighborhoods 27 and 45, which comprise approximately 3/4 of zipcode 02115.
- Mission Hill, Lower Roxbury includes Neighborhoods 46, 47 and half of Neighborhood 53 (Lower Roxbury), zipcode 02120.

The housing stock is divided into three major categories; owner occupied, private rental stock and subsidized housing. Table 3-1 displays the 1987 and 1994 housing stock by neighborhood, and for the City as a whole. Within the owner occupied stock, condominiums and single family units are presented separately.

Private rental units can be either subject to the Rent Equity Board or non-controlled. Most units constructed prior to 1967 are under the Rent Equity Board jurisdiction. Nearly 60 percent of all private rental units in the city are rent equity board units. The rents on these units can be raised to market level whenever a new tenant enters. About 30 percent of the 72,700 Rent Equity Board units are rent controlled, where no turnover has occurred since the ordinance. For these units the maximum rents are set at the 1972 level and adjusted forward using the Boston SMSA urban consumer price index. The remaining 70 percent of Rent Equity Board units are vacancy decontrolled. Tenants in these units have a right to "grieve" annual increases of over 10 percent or CPI for Class A tenants (elderly, low income or physically or mentally handicapped). (This may not be an effective cap in market rents based on recent Abt Associates research, which showed that statewide the average annual rent increase for tenants

Table 3-1
1987 and 1994 Housing Stock

	Boston	Back Bay, Beacon Hill	South End	Kenmore, Fenway	Roxbury Mission Hill	Rest of Boston
1987 Stock						
Owner Units						
Owner Occ.	58750	977	1650	100	600	55423
Condos	31500	6588	2300	3100	650	18862
Subsidized	44750	1175	5450	1550	3563	33012
Private Rentals						
Rent Controlled	21500	2650	1050	2000	390	15410
Vacancy Decontrol	51200	8250	2050	6250	706	33944
Non-Controlled	49650	588	2100	150	979	45833
1994 Stock						
Owner Occ (=1987)	58750	977	1650	100	600	55423
Condos (old + new + conversions)	51480	9046	3941	4034	1747	15401
Rental (old + new - conversions)	116525	10467	4917	7963	4124	89052
Condo Conversions (88-94)	12165	1741	826	638	92	8869
Rent Controlled Units in 1994	9902	1077	527	812	202	7284

Data Sources:
1987 - Boston Redevelopment Authority
1994 - Estimated using BRA data & Rolf Goetze data

with at least one year tenure in their units was 3.05 percent).[6] The non-controlled stock (49,650 units in Boston) includes units in buildings built after 1967 as well as units in older two family or owner occupied three family houses.

The entire subsidized housing stock is included as one category, since for the purposes of this study, subsidized units are not considered part of the stock available to the new inmigrants. To the extent that some inmigrant employees are able to use subsidized or rent-controlled units, the impacts estimated in Section 4 would be reduced.

3.2 1994 Housing Stock

The Prudential redevelopment is expected to come on line starting in 1994. We assume that the total number of inmigrating employees will be spread evenly over the five years 1994-1998. Thus, the 1994 housing stock is used as the base for estimating impacts. The housing stock available to owner and renter inmigrants will change each year due to new construction, conversions from rental to condominium, and decontrol of rent controlled stock. Estimates of the 1994 housing stock were obtained under the following assumptions:

3.2.1 New Construction

The rate of new additions to both the owner and renter stock in each year from 1988 will be the same as the 1985-1988 rate (calculated using the BRA Ultralist, a listing of all planned housing construction, including expected tenure and number of units).[7] From the BRA lists we extracted the number of non-subsidized new units expected to be completed for each year 1985-1988, by tenure. The average number of new units per year is used as the expected number of annual additions to the stock for future years. (Projects where the owner/renter tenure was unknown were allocated according to the tenure distribution of known projects). Discussions with BRA staff confirm that for the timeframe of this project (through 1998) no neighborhoods will "use up" available sites for construction at the 1985-1988 rate.

Annual additions to the owner and renter stock are presented in Table 3-2.

The Fenway and Kenmore impact neighborhoods are combined to conform with the BRA neighborhood definitions.

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[6] Chapter 707 Rent Study Follow-Up, Abt Associates Inc., September 1988.

[7] John Avault and Mark Johnson, "A Survey of Residential Developments in Boston's Neighborhoods 1975-1989", BRA, Policy Development and Research Department, April, 1987.

Table 3-2
New Construction

	Boston	Back Bay, Beacon Hill	South End	Kenmore, Fenway	Roxbury (1/10 of Pln Area)	Rest of Boston
New Construction:						
Annual:						
Owner Units (condos)	1116	102	116	42	15	840
Rental Units	906	103	78	29	9	687
1988-1994:						
Owner Units (Condos)	7815	717	815	296	105	5882
Rental Units	6340	720	543	201	66	4810

Assume that the Prudential condominiums will come on during the final three years. 280-350 units are expected, assume 315 (average), and 1/3 each year 1996-1998, 105 additional condos in Back Bay in each of those.

Source: Calculated using BRA Ultralist data.

BRA staff report that due to SENHI and other unique developments in 1984-1988 the renter/owner breakdown obtained using those years as a base overestimates rental construction in the South End. Therefore, for the South End, the total number of projected units is assumed to be 60 percent owner units and 40 percent rental units. (The 1984-1988 rates were 12 percent owner units and 78 percent rentals).

3.2.2 Conversions From Rentals to Condominiums

In the period 1980 to 1987 approximately 27,000 condominium units were added to the housing stock in Boston. The majority of new additions to the condo stock have taken place since 1985. Citywide, over 80 percent of condominiums were added through conversions from rental units. In all the impact area neighborhoods except Roxbury, the percent of condos added through conversions was even higher then the city average (87 percent in Fenway, 93 percent in the South End, 97 percent in Back Bay, and 40 percent in Roxbury).[8]

Overall, from 1980 to 1987, about 19 percent of the 1980 private rental stock was lost due to conversions from rental units to condominiums, a citywide average of 3 percent of the stock per year. The average annual rate varied by neighborhood, from a low of 0.3 percent in Roxbury, up to 4.9 percent of the stock per year in Back Bay.[9]

During the next few years, several factors will impact the rate of condo conversions. The new tax laws of 1986 enhance the benefits of condo tenure, making conversions an appealing option. However, the recent glut in condos reported by Boston area realtors, as well as the stricter conversions regulations imposed by the city, are expected to curb conversions.

Due to these factors, we assume that in each neighborhood in the city the rate of conversion from rental units to condominiums will slow to half its 1980-1987 rate. Conversions apply to the 1987 housing stock, and are presented in Table 3-3. One exception is Roxbury, where the condominium conversion and construction process began only in 1985. We therefore assume that in Roxbury the 1988-1998 rate of conversion will continue as it was over the period 1980-1987.

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[8]See BRA Condominium Memorandum, August 11, 1988, and Boston Housing Facts and Figures, BRA.

[9]See Boston's Housing, 1988: An Informational Report (BRA, May, 1988).

Table 3-3
Condo Conversions

Conversions:	Total Boston	Back Bay, Beacon Hill, Bay Vill.	South End	Fenway, Kenmore	Mission Hill, Lower Roxbury	Rest of Boston
1980-87 Rate:	2.97%	4.64%	4.88%	4.59%	0.32%*	
Half	1.49%	2.32%	2.44%	2.30%	0.16%	
Conversions 87-94	12165	1741	826	1260	92	8247
1995	1636	226	107	164	13	1127
1996	1612	221	104	160	13	1114
1997	1588	216	102	156	13	1101
1998	1564	211	99	153	13	1089

Calculated using BRA data.

* Mission Hill/Roxbury conversions 1987-1998 are assumed to continue at the 1980-1987 rate.

Although in the past conversions typically produced more than one condo for every apartment lost (large units being subdivided into smaller units), we will assume that one new unit is added for every apartment lost.

It is expected that as of 1994 20 percent of all condominiums will be rented out. In a national study on conversions of rental units to condos (The Conversion of Rental Housing to Condominiums and Cooperatives, August 1980, HUD-PDR 554(2)), it was found that 37 percent of units in newly converted buildings were renter occupied, 54 percent of whom were pre-conversion tenants renting from the converter/developer as part of the conversion process. Over time, it is expected that fewer units will be rented out.

3.2.3 Rent Controlled Units

Between 1976 when vacancy decontrol was enacted and 1987, 70 percent of all Rent Equity Board units have become decontrolled, a citywide average annual rate of 10 percent. Assuming that the same rate of decontrol continues, 47 percent of the currently controlled stock will remain controlled in 1994 (0.9 to the 7th power). The actual percent is calculated individually for each neighborhood. The number of controlled units expected to remain in each neighborhood in each year is displayed in Table 3-4. Since units remain controlled only if they do not turn over, we assume that the controlled stock is not part of the stock available to the new Prudential employees.

3.2.4 Demolitions

The number of buildings being demolished will continue to be small, thus it is being ignored here. The 1988 Abt study on Housing Supply and Demand in Massachusetts shows that between 1980 and 1986, 0.42 percent of the Boston housing stock was demolished.[10] (1,394 units out of the 1980 stock of 241,444).

3.2.5 Turnover

In calculating the housing supply available for the new inmigrant employees looking for housing, we consider the number of units turning over each year, in other words the number of units that change hands. The new inmigrant employees and other housing seekers compete for these units. The rates at which units turn over is derived using Boston Redevelopment Authority figures on the length of time tenants reside in their units for each neighborhood, as reported in the 1988 neighborhood profiles.

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[10] "Massachusetts Housing Inventory and Policy Indicators", Abt Associates Inc., July 1988, pp. 67-79.

Table 3-4
Rent Controlled Housing Stock

	Total Boston	Back Bay, Beacon Hill, Bay Village	South End	Fenway, Kenmore	Mission Hill, Lower Roxbury	Rest of Boston
Percent Vacancy Decontrolled Per Year						
1976-1987	10.48%	12.06%	9.37%	12.09%	8.97%	
Controlled Stock:						
1994	9902	1077	527	812	202	7284
1995	8864	947	478	714	184	6541
1996	7935	833	433	627	167	5874
1997	7103	733	392	552	152	5274
1998	6358	644	356	485	139	4735

Source: Calculated using BRA data.

For example, suppose a neighborhood has a housing stock of 1000 units and that half the tenants (500) have lived in their units under two years and half (500) 2 to 5 years. We estimate that the average turnover rate for the first group is every 1.5 years, and for the second group every 3.5 years. Thus each year 333 (500/1.5) of the short term tenants vacate their units, as do 143 (500/3.5) of the longer term tenants. Therefore, a total of 476 (333+143) out of the 1000 units in neighborhood XX change hands every year (47.6 %).

Table 3-5 displays the BRA estimates of the length of tenure distribution by neighborhood and the resulting number of units by length of tenure. Owners tend to stay in units longer than renters, but The BRA figures do not distinguish between owners and renters. To correct for differences in length of tenure between owners and renters, we used citywide owner/renter tenure rates from the Annual Housing Survey. (The Annual Housing Survey is a survey of characteristics of housing units and their residents done at a national and SMSA level. The Central City Boston survey for 1981 is used here).[11] Table 3-6 shows the number of units and percent of stock turning over every year for each neighborhood, and the adjustments made for renters/ owners.

3.3 Stock Available Each Year

For estimating the number of owner units turning over annually, we include all traditional owner occupied units as well as 80 percent of the condominiums. The relevant stock of rental units includes non-controlled units, vacancy decontrolled units and 20 percent of the condominium stock. Rent controlled units are excluded from the available stock (until the point at which they are vacancy decontrolled). Because about 20 percent of condominiums are rented out, they are included in the rental stock available to housing seekers. We exclude subsidized units entirely from the base of rental units available to inmigrant employees.

We also assume that all new construction is available in the year it is completed. In following years, the units are available at the turnover rate. Table 3-7 shows the number of owner and renter units available each year by neighborhood.

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[11] "Annual Housing Survey 1981 Housing Characteristics for Selected Metropolitan Areas," Boston, Massachusetts, (U.S. Department of the Census, 1984), Table B-1, p. A-45.

TABLE 3-5

Length of Tenure Distribution by Neighborhood

	Boston	Back Bay B. Hill	South End	Kenmore Fenway	MHill L Roxy
<2 years	0.28	0.57	0.31	0.69	0.20
2-5 yrs	0.27	0.20	0.32	0.23	0.35
6-10 yrs	0.16	0.12	0.19	0.03	0.22
11-15 yrs	0.10	0.05	0.07	0.00	0.10
16+ yrs	0.19	0.06	0.10	0.05	0.14

Source: BRA Neighborhood Profiles, 1988

Number of Units by length of tenure
(Total units, weighted by length of tenure distribution)

<2 years	72058	11528	4526	4209	1378
2-5 yrs	69485	4045	4672	1403	2411
6-10 yrs	41176	2427	2774	183	1515
11-15 yrs	25735	1011	1022	0	689
16+ yrs	48897	1214	1460	305	964

Turnover by length of tenure:
We assume that under 2 years turn over every 1.5 years
16+ years turn over every 20 years
All other units turn over at the midpoint of their range
(3.5 years, 8 years and 13 years respectively)

Units turning over by length of tenure:

<2 yrs	48039	7686	3017	2806	918
2-5 yrs	19853	1156	1335	401	689
6-10 yrs	5147	303	347	23	189
11-15 yrs	1980	78	79	0	53
16+ yrs	2445	61	73	15	48
Annual Turnover	77463	9283	4851	3245	1898
percent of stock	30.10%	45.90%	33.22%	53.20%	27.55%

Source: BRA Neighborhood Profiles

TABLE 3-6

AHS Tenure Distribution - Citywide

	Owners	Renters	Rate of turnover (midpoints assumed)
:1.5 yrs	0.07	0.27	every yr
.5-6 yrs	0.28	0.47	every 3.75 yrs
'-11 yrs	0.12	0.11	every 9 yrs
.2-21 yrs	0.23	0.10	every 16.5 yrs
22-31 yrs	0.12	0.02	every 26.5 yrs
32+ yrs	0.18	0.02	every 38 yrs
lean	16 yrs	5.84 yrs	

Units by length of tenure (AHS) - Citywide

	Owner	Renter	Units Turning Over Annually Owner	Renter	All
:1.5 yrs	6318	33035	6318	33035	39352
..5-6 yrs	25270	57505	6739	15335	22073
'-11 yrs	10830	13459	1203	1495	2699
.2-21 yrs	20758	12235	1258	742	2000
22-31 yrs	10830	2447	409	92	501
32+ yrs	16245	2447	428	64	492
		Annual Turnover:	16354	50763	67116
		Percent of Total:	18.12%	41.49%	31.57%

Adjusting total turnover rate to account for owners/renters
(NBHD turnover * AHS city owner or renter /AHS city total)

	Boston	Back Bay B. Hill	South End	Kenmore Fenway	MHill L Roxy
Owners	17.28%	26.35%	19.07%	30.53%	15.81%
Renters	39.56%	60.32%	43.66%	69.91%	36.21%

Source: Annual Housing Survey: Housing Characteristics of Boston, 1981

Table 3-7
Stock Available for Owners/Renters
(Accounts for Turnover, Construction, Condo Conversions, Rent Control, etc.)

	Boston	Back Bay, Beacon Hill	South End	Kenmore, Fenway	Roxbury (1/10 of Pln Area)	Rest Of Boston
1994 Stock:						
Available to Own:	17266	2164	916	1016	316	12854
Available to Rent:	46252	6756	2261	5564	1547	30124
1995 Stock:						
Available to Own:	18385	2294	1025	1090	330	13647
Available to Rent:	47901	6900	2374	5608	1574	31446
1996 Stock:						
Available to Own:	18762	2446	1059	1139	333	13785
Available to Rent:	48139	6930	2399	5601	1579	31630
1997 Stock:						
Available to Own:	19136	2535	1092	1188	337	13985
Available to Rent:	48354	6956	2422	5589	1585	31802
1998 Stock:						
Available to Own:	19507	2623	1125	1235	340	14183
Available to Rent:	48547	6977	2446	5574	1589	31961

4.0 IMPACTS

The Prudential expansion may impact housing prices in two ways. The first is a result of increased employment (direct and indirect). A certain fraction of employees in the new development will move to Boston, adding pressure to the housing market. A second component of the impact results from induced demand. Induced demand is the additional demand for housing in the neighborhood due to the increased attractiveness of the environs of the Prudential as a place to live. Both types of impacts are marginal impacts, in addition to the underlying price trends.

Boston housing prices recently have undergone very substantial general increases, followed by a current leveling off, particularly in condominiums, the primary form of ownership housing being marketed in the impact area. For example, the median price for condominium sales in all of downtown Boston increased by 24 percent during 1985, then by 21 percent during 1986, and again by 12.5 percent during 1987, based on real estate transactions reported by County Home Data of Shelburne, Vermont. We are not trying to predict what such patterns might be in the period when the proposed Prudential Center Redevelopment would come onstream--roughly 1994 through 1998--but what the additional effect of the Prudential Center Redevelopment could be.

4.1 Impacts Due to Employment

When an increased number of people compete for an existing stock of housing, the market responds by either building more housing or raising prices. Since construction of new housing takes time, it is only a long run solution. In the short run, the primary response to added demand will be increased prices. The degree of increase depends on the number of new residents relative to the available stock. The tighter the market (fewer units turning over each year), the more additional pressure a given number of people will cause.

Different assumptions regarding the exact degree of relationship between housing demand and prices will alter the expected price change caused by the demand change. In a simple example, a one percent increase in the demand for housing would lead to a one percent increase in prices. For example, if 10 more households were seeking housing in a neighborhood where 1000 units normally change hands annually, a 1 percent increase in prices would occur. If the average rent was $500, it would rise to $505.

Research has shown that in the case of rents, particularly for lower income households, a 1 percent increase in demand leads to a 3.3 percent increase in rents.[12] (Technically, this means that the price elasticity of demand is -0.3). In the example above, this would mean that the 10 additional households seeking housing would cause prices to rise by 3.3 percent, from $500 to $516.5.

In the case of ownership prices, little research has been done, so we will apply the standard 1 percent rule.

Based on our estimates of increased demand and existing housing stock in each neighborhood, along with our estimates of price responsiveness to increased demand, we have estimated the price increases in each neighborhood due to the added employment related demand. Table 4-1 shows the total employment-driven impacts by neighborhood for owners and renters. The table shows that in the first year of the project, rents for units turning over are expected to rise by 0.5 percent and prices by 0.4 percent. The overall five year increase in rents in the impact area is 2.7 percent, with the highest impact of 3.1 percent in the Back Bay area. For owner units the overall impact is expected to be 1.6 percent, with the highest price increase of 2.0 percent in the Back Bay area. In order to illustrate the methodology, calculations for the South End are presented in Appendix 2.

The average rent income ratio in Boston in 1984-85 was 27 percent (ranging from a low of 24 percent in Back Bay to 28 percent in the Fenway/Kenmore area). Assuming that incomes remain constant, the increases in rents would affect rent income ratios additively. In other words, in the first year, the average rent income ratio for movers would be 0.5 percent higher. However, since only a fraction of units change hands annually, the overall increases in average rent income ratios would be lower. These impacts are so small that one would not expect to see discernable displacement of current residents prompted solely by the predicted marginal increases in the burden of housing costs attributable to the Prudential Center redevelopment.

In the next two subsections of this report we investigate what difference in predicted impacts would result under different assumptions in the estimation model. This is to determine whether the overall conclusions of dispersed impacts and relatively

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[12]Housing Allowance Demand Experiment, "The Demand for Rental Housing: Evidence from a Percent of Rent Housing Allowance," Abt Associates Inc., June 1980, p. 76.

TABLE 4-1
PROJECT IMPACTS

'otal additional owners/renters due to the project (using Herr assumptions on employment and Cambridge Systematics 1987 survey)

	Boston	Back Bay w/Charles	South End	Kenmore, Fenway	Mis.Hill LwrRoxy	Rest of Boston	Total Impact Ar
nmigrant Households:							
)wner	311	48	13	15	3	232	79
Renter	399	65	17	44	5	268	131
ssuming that additional workers inmigrate over the 5 yr period nnual additions to house-seekers:							
)wner	62	10	3	3	1	46	16
Renter	80	13	3	9	1	54	26

lasticity of demand: -0.3 for rental units
-1 for owner units

Rental Impacts:

1994:	0.58%	0.64%	0.50%	0.53%	0.22%	0.59%	0.54%
1995:	0.56%	0.63%	0.48%	0.53%	0.21%	0.58%	0.53%
1996:	0.56%	0.63%	0.48%	0.53%	0.21%	0.57%	0.53%
1997:	0.56%	0.62%	0.47%	0.53%	0.21%	0.57%	0.53%
1998:	0.55%	0.62%	0.47%	0.53%	0.21%	0.57%	0.53%
Total:	2.8%	3.1%	2.4%	2.6%	1.1%	2.9%	2.7%

)wner Impacts:

1994:	0.36%	0.44%	0.28%	0.30%	0.19%	0.36%	0.36%
1995:	0.34%	0.42%	0.25%	0.28%	0.18%	0.34%	0.33%
1996:	0.33%	0.39%	0.25%	0.26%	0.18%	0.34%	0.32%
1997:	0.33%	0.38%	0.24%	0.25%	0.18%	0.33%	0.31%
1998:	0.32%	0.37%	0.23%	0.24%	0.18%	0.33%	0.30%
Total:	1.7%	2.0%	1.3%	1.3%	0.9%	1.7%	1.6%

small expected rent and price changes due to the Prudential Center redevelopment would be changed under different assumptions.

4.1.1 Alternative Assumptions

The estimated impacts presented above vary depending on the assumptions we make regarding inmigration patterns and price responsiveness to demand. Changes can be made to model parameters such as job factors or household composition. For example, if none of the new jobs created by the development cause the displacement of old jobs (displacement factor equals zero) the result would be 886 new Boston households (compared with 710 households in the base case). The impact of these new households would be a 3.4 percent increase in rents in the impact area over five years, and 2.4 percent in prices, with a maximum of 3.9 percent rent increases and 2.8 percent price increase in Back Bay. Tables A1-A3 showing the employment and price impacts resulting from this scenario are displayed in Appendix 1, as are tables supporting the other alternatives described.

If each inmigrant brought an entire household into the city (instead of the current assumptions regarding multiple workers, which led to assumptions of 1.05-1.4 employees per household), and all other assumptions were unchanged, 862 new households would be expected to move into the city. This would raise rents in the impact area by 3.5 percent and prices by 1.8 percent over 5 years with a maximum of 4.2 percent rent increases and 2.2 percent price increase in Back Bay. (See Tables A4-A5).

If, on the other hand, there were 1.4 new employees per household, as is the citywide average, the 5 year increase in rents would be 2.6 percent, and the increase in prices would be only 1.3 percent over 5 years (see Tables A6-A7).

If we account only for the direct employment generated by the Prudential Center redevelopment and omit indirect employment impacts (business purchase jobs factor, employee purchase jobs factor and attracted jobs factor all equal zero), the project would directly cause the inmigration of 551 households, raising rents in the impact area by 2.1 percent over 5 years and prices by 1.3 percent (Tables A8-A10).

4.1.2 Sensitivity Analysis of Employment Generation Factors

To test the sensitivity of the estimated impact to the model assumptions, two additional alternatives were tested. First, we changed all the model parameters by 25 percent in the employment enhancing direction, and then in the employment reducing direction. The first test measures how much higher the rent and price increase would be if all factors which increase inmigration (business purchase jobs factor, employee pur-

chase jobs factor, and attracted jobs factor) were raised by 25 percent and all factors which reduce the number of inmigrants (displacement jobs factor, jobs held by previously unemployed, not in the workforce, or outcommuters) were reduced by 25 percent. The result would be inmigration of 808 households (compared with the base case of 710). The resulting rent increase over 5 years would be 3.5 percent, compared with the base case of 2.7 percent (see Tables A11-A13).

Making the opposite changes (raising inmigrant reducing factors and lowering inmigrant enhancing factors) would yield 542 inmigrant households and a 5 year rent increase of 2.1 percent in the impact area (see Tables A14-A16).

Table 4-2 compares the predicted first-year impacts for the base case and for the alternative assumptions and sensitivity tests, using reference rents of $300, $500 and $800 per month and reference condominium prices of $100,000, $150,000 and $200,000. As the table illustrates, none of the tested variations in assumptions in the impact prediction model cause an appreciable shift in the basic patterns developed in the base case.

In conclusion, we observe that the employment-generated impacts on housing from the proposed Prudential Center redevelopment are quite dispersed throughout the Boston metropolitan area housing market, and that the possible range of marginal impacts on the costs of housing in the impact area around the Prudential Center redevelopment would cause increases typically well under one percent annually, even under quite a broad range of assumptions in the impact prediction model. This translates to monthly rent increases in the first year typically well under $5 for an apartment that would rent for $500 or to condominium price increases typically under $600 for a condominium that otherwise would sell for $150,000.

4.2 Impacts due to Induced Demand

In addition to estimating the impacts due to increased employment, we have estimated the range of possible induced housing demand. This estimate is based on data on condominium prices around Copley Place, a neighboring commercial development completed in mid-1985 with which the Prudential Center is often compared. Any price increases due to induced demand are, of course, embedded in underlying price increases of the Copley Place project; one only observes the overall price trend.

To estimate the price increases due to Copley we calculated the average selling price for condominiums in Back Bay and South End, excluding Copley, in 1982-1984 and 1985-1987, and separately for the Copley Place neighborhood for the same period (see

TABLE 4-2

Predicted Rents and Housing Prices

Scenario:	Pre-Impact (1993) Rent	First-Year (1994) Rent	5th-Year Rent
Base Case	$300	$302	$308
No Displacement Jobs	$300	$302	$310
One Worker per Household	$300	$302	$311
1.4 Workers per Household	$300	$302	$308
No Indirect Employement	$300	$301	$306
Sensitivity Analysis 1 (increases inmigration)	$300	$302	$311
Sensitivity Analysis 2 (decreases inmigration)	$300	$301	$306
Base Case	$500	$503	$514
No Displacement Jobs	$500	$503	$517
One Worker per Household	$500	$504	$518
1.4 Workers per Household	$500	$503	$513
No Indirect Employement	$500	$502	$511
Sensitivity Analysis 1 (increases inmigration)	$500	$504	$518
Sensitivity Analysis 2 (decreases inmigration)	$500	$502	$510
Base Case	$800	$804	$822
No Displacement Jobs	$800	$806	$827
One Worker per Household	$800	$806	$828
1.4 Workers per Household	$800	$804	$821
No Indirect Employement	$800	$803	$817
Sensitivity Analysis 1 (increases inmigration)	$800	$806	$828
Sensitivity Analysis 2 (decreases inmigration)	$800	$803	$816

TABLE 4-2

(Continuation)

Scenario:	Pre-Impact (1993) Price	First-Year (1994) Price	5th-Year Price
Base Case	$100,000	$100,360	$101,600
No Displacement Jobs	$100,000	$100,530	$102,400
One Worker per Household	$100,000	$100,390	$101,800
1.4 Workers per Household	$100,000	$100,280	$101,300
No Indirect Employement	$100,000	$100,280	$101,300
Sensitivity Analysis 1 (increases inmigration)	$100,000	$100,460	$102,100
Sensitivity Analysis 2 (decreases inmigration)	$100,000	$100,270	$101,200
Base Case	$150,000	$150,540	$152,400
No Displacement Jobs	$150,000	$150,795	$153,600
One Worker per Household	$150,000	$150,585	$152,700
1.4 Workers per Household	$150,000	$150,420	$151,950
No Indirect Employement	$150,000	$150,420	$151,950
Sensitivity Analysis 1 (increases inmigration)	$150,000	$150,690	$153,150
Sensitivity Analysis 2 (decreases inmigration)	$150,000	$150,405	$151,800
Base Case	$200,000	$200,720	$203,200
No Displacement Jobs	$200,000	$201,060	$204,800
One Worker per Household	$200,000	$200,780	$203,600
1.4 Workers per Household	$200,000	$200,560	$202,600
No Indirect Employement	$200,000	$200,560	$202,600
Sensitivity Analysis 1 (increases inmigration)	$200,000	$200,920	$204,200
Sensitivity Analysis 2 (decreases inmigration)	$200,000	$200,540	$202,400

enclosed map in Exhibit 4-1). The average increase in Back Bay and South End, excluding Copley, was 81 percent and for the Copley area 86 percent during the period. For the city as a whole, prices in the 85-87 period rose by 52 percent over those of the 1982-84 period. In other words, the Copley area experienced a 2.6% (1.86/1.81) higher increase in prices. (Table 4-3 shows the price trends in the city as a whole, in the Back Bay, South End, and Copley neighborhoods and Exhibit 4-2 shows the results graphically.)

Assuming that half the additional increase was due to the development, and the other half was due to other events, such as the employment related demand and opening of the Back Bay rail station, we can say that Copley caused a 1.3 percent increase in prices in its neighborhood.

Members of the PruPAC Housing Subcommittee have suggested that the Prudential Center expansion will cause about 7/8ths of the level of induced demand caused by the Copley Place development, or a 1.1 percent increase in prices. However, our discussions with local realtors, as well as our knowledge of the differences in the two projects have led us to assume that the impact of the Prudential redevelopment is in the range of 0 to 20 percent of the Copley development. Among the differences in the two projects which would effect induced demand are the different starting points of the two projects. Copley Place replaced a highway interchange, while the Prudential Center is expanding an existing development, with much smaller relative changes in character and appearance. The differences in the usage of the development may also have different induced demand impacts.

Table 4-4 shows that Copley has a higher proportion of non-office space compared with the proposed Prudential expansion (77 percent versus 40 percent) which may lead to higher induced demand in the Copley situation because the employees are in occupational categories more likely to seek residences close by.

Copley had a higher proportion of hotel and retail workers (46%) compared with the proposed Prudential redevelopment (15%). These workers tend to be lower paid and therefore are likely to be renters. In addition, the Cambridge Systematics Survey showed that retail workers tend to live closer to the impact area than office workers. These factors would cause a higher employment related impact due to Copley compared with the Prudential expansion.

Assuming that the Prudential expansion has 20 percent of the impact of Copley, we can expect a 0.3 percent increase in condominium prices in the environs of the Prudential Center caused by induced demand. For example, this would produce an increase

Exhibit 4.1

Copley Place Induced Demand Analysis Area

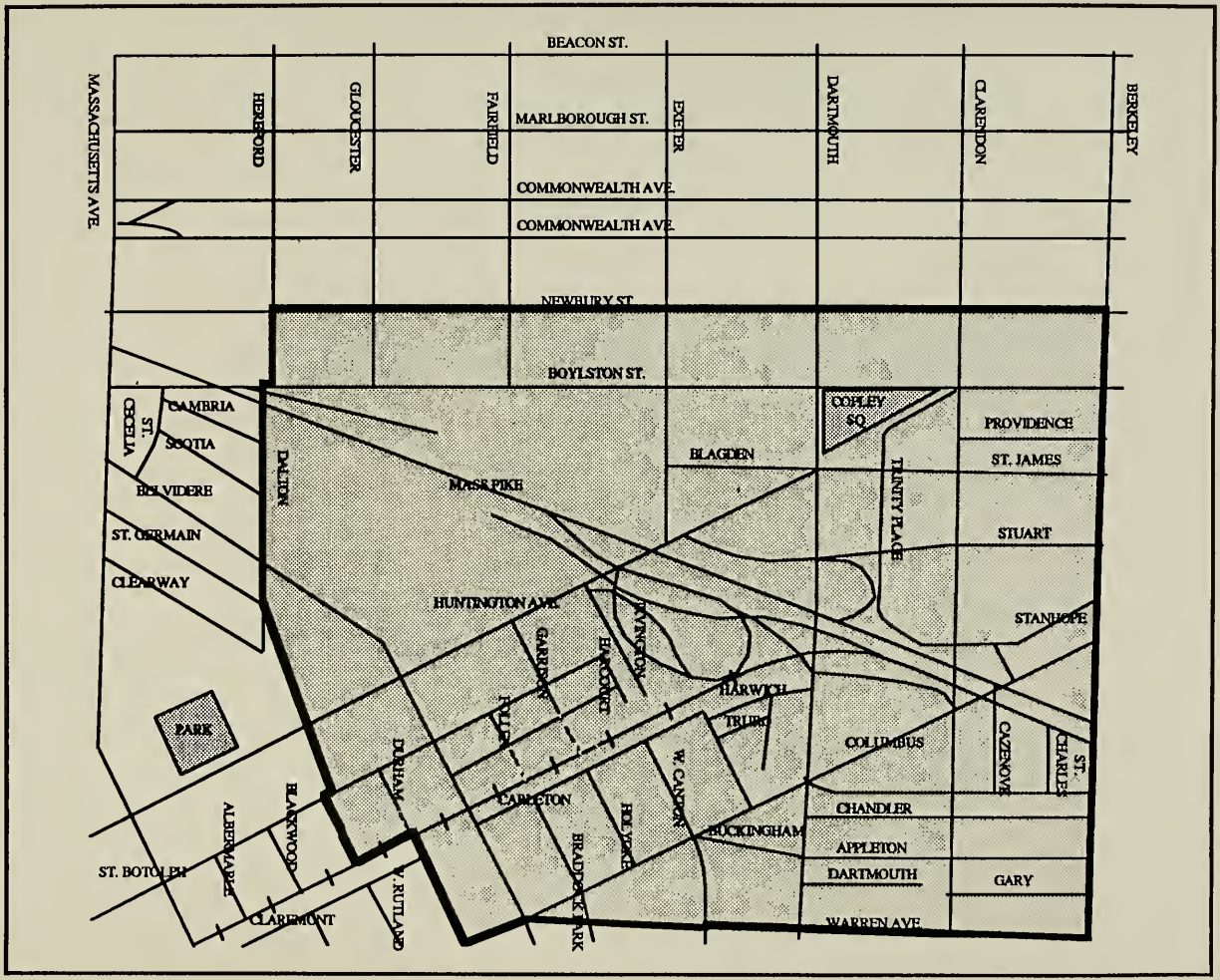

TABLE 4-3

Average Condo Prices

	1982	1983	1984	1985	1986	1987	Total
Avg Price:							
Boston	92000	94000	116000	145000	162000	175000	131000
Copley	77000	74000	95000	159000	157000	155000	177000
South End	94000	79000	111000	152000	195000	156000	137000
Back Bay	94000	102000	128000	183000	209000	197000	155000
BB+SE-CO*	98000	103000	132000	186000	228000	193000	160000
Number of Transactions:							
Boston	1262	2759	2881	3449	3312	1010	14673
Copley	67	128	176	240	201	174	986
South End	33	120	178	109	130	201	771
Back Bay	340	745	737	838	904	156	3720
BB+SE-CO*	306	737	739	707	833	183	3505

* BB+SE-CO = Back Bay + South End - Copley
Excluding Copley Units from the South End and Back Bay

Weighted Average price

	1982-84	1985-87	ratio 82-84/85-87
Boston	102817	156145	1.518657
Copley	84504	157215	1.860439
South End	97704	166532	1.704453
Back Bay	111024	196534	1.770193
Back Bay+ South End-Copley	114168	207049	1.813547
Ratio of Copley to Back Bay+South End-Copley:			1.025856

EXHIBIT 4-2

Average Price for Condos
1982-1987

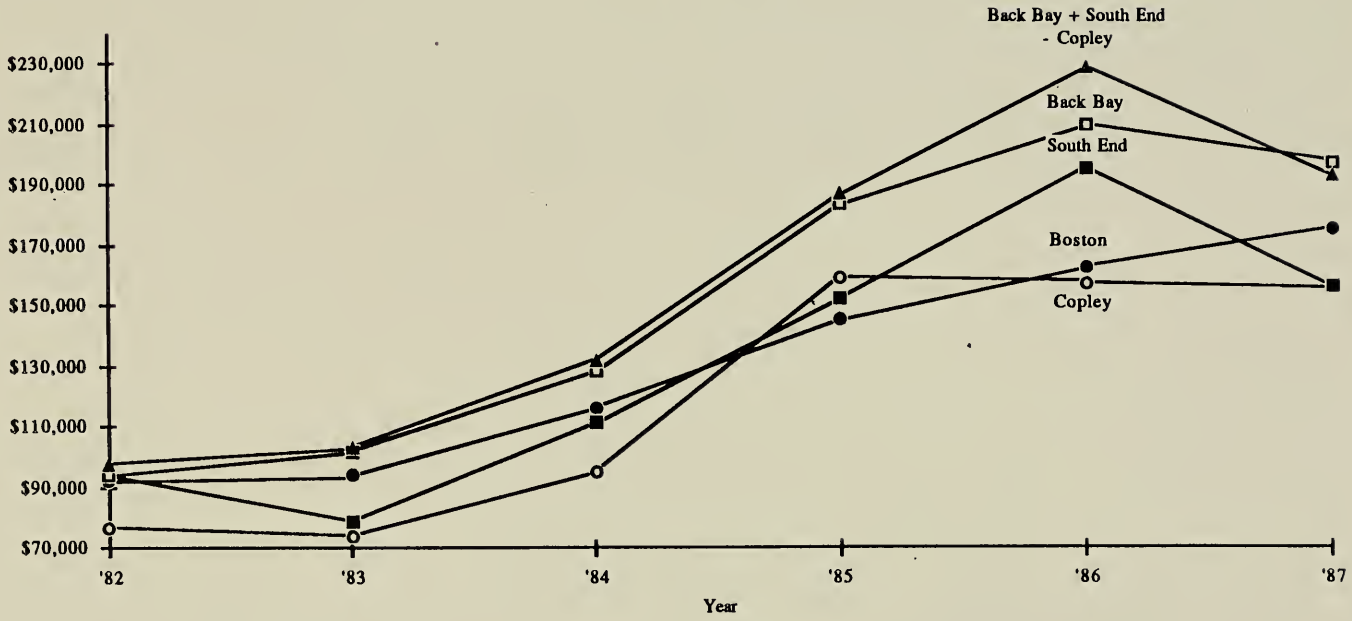

Table 4-4
Copley and Prudential Space Allocation and Resulting Employment

	Copley				Prudential Redevelopment			
	Office	Retail	Hotel	Total	Office	Retail	Housing	Total
Area (SF)	845,000	370,510	2,484,190	3,700,000	935,000	241,000	373,000	1,548,000
SF/Employee	213	306			213	306		
Rooms			1,951					
Room/Employee			0.9091					
Employees	3,967	1,211	2,146	7,324	4,390	788		5,177
	(54%)	(17%)	(29%)	(100%)	(85%)	(15%)		(100%)

of $450 in a condominium that otherwise would be prices at $150,000. We do not have an empirical basis for estimating what the effects of induced housing demand might be on rents. Our judgment is that effects on rental prices would be less, primarily because the life-style character of induced demand is more likely to be important at the upper end of the housing market which condominiums serve more than for rental housing.

APPENDIX 1

Sensitivity Analysis: Changes in Predicted Impacts as Key Parameters are Changed

TABLE A-1

PRUDENTIAL REDEVELOPMENT HOUSING IMPACT ESTIMATES: EMPLOYMENT-RELATED DEMAND

Displacement Jobs = 0

	OFFICE	RETAIL	HOUSING	TOTAL	SOURCE
GROSS RENTABLE AREA (SF)	935,000	241,000	372,000	1,548,000	PROJECT NOTIFICATION FORM
AREA/EMPLOYEE	213	306			PHIL HERR, "PNF REPORT FRAGMENTS," APRIL 15,
ON-SITE NEW EMPLOYEES	4,390	788		5,177	
DISPLACEMENT JOBS FACTOR	0.000	0.000			PHIL HERR
DISPLACEMENT JOBS	0	0		0	
NET JOBS ADDED	4,390	788		5,177	
INDIRECT EMPLOYMENT GENERATION:					
BUSINESS PURCHASE JOBS FACTOR	0.180	0.101			HERR
BUSINESS PURCHASE JOBS	790	80		870	
EMPLOYEE PURCHASE JOBS FACTOR	0.050	0.050			HERR
EMPLOYEE PURCHASE JOBS	219	39		259	
ATTRACTED JOBS (AGGLOMERATION) FACTO	0.100	0.100			HERR
ATTRACTED JOBS	439	79		518	
TOTAL JOBS GENERATED	5,838	985		6,823	
FRACTION BOSTON RESIDENTS	0.213	0.422			CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY
NUMBER BOSTON RESIDENT JOBS	1,242	415		1,658	
JOBS OF PREVIOUSLY UNEMPLOYED FACTOR	0.064	0.087			HERR
JOBS OF PREVIOUSLY UNEMPLOYED	80	36		116	
ADDED WORKERS NOT PREVIOUSLY IN LABOR FORCE, FACTOR	0.064	0.101			HERR
ADDED WORKERS NOT PREV. IN LABOR FOR	80	42		122	
FORMER OUTCOMMUTER FACTOR	0.234	0.215			HERR
FORMER OUTCOMMUTERS	290	89		379	
NET BOSTON IMMIGRANT EMPLOYEES	792	248		1,040	

TABLE A-2

Estimated Distributions of Immigrant Employees and Households

Displacement Jobs = 0

	IMPACT AREAS (BY ZIPCODE ASSOCIATIONS)									
	BACK BAY 02108	KENMORE N. FENS	MEDCTR E. FENS	ROXBURY Xing	SOUTH END	IMPACT AREA	REST OF BOSTON	TOTAL BOSTON	OUTSIDE BOSTON	TOTAL
ZIPCODES	02116,99 1/2 02114 1/4 02115	02215	3/4 OF 02115	02120	02118		02101-13 1/2 02114 19-37,02210		ALL OTHER ZIPCODES	
OFFICE:										
FRACTION OF TOTAL EMPL.*	0.0316	0.0049	0.0103	0.0020	0.0069	0.0557	0.1571	0.2128	0.7851	0.9979
BOSTON FRACTION, TOT EMPL.	0.1485	0.0230	0.0484	0.0094	0.0324	0.2617	0.7383	1.0000		
BOSTON IMMIGRANT EMPLOYEES	118	18	38	7	26	207	585	792		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61	FROM BRA NEIGHBORH	
IMMIGRANT RENTER EMPLOYEES	73	14	30	5	16	138	345	483		
RENTER EMPLOYEES/HOUSEHOLD	1.3	1.3	1.3	1.3	1.3			1.3		
BOSTON RENTER HOUSEHOLDS	56	11	23	4	12	106	266	372		
IMMIGRANT OWNER EMPLOYEES	45	4	8	2	10	69	240	309		
OWNER EMPLOYEES/HOUSEHOLD	1.05	1.05	1.05	1.05	1.05			1.05		
BOSTON OWNER HOUSEHOLDS	43	4	8	2	9	66	228	294		
RETAIL:										
FRACTION OF TOTAL EMPL.*	0.0937	0.0187	0.0491	0.0093	0.0405	0.2113	0.2102	0.4215	0.5794	1.0009
BOSTON FRACTION, TOT EMPL.	0.2223	0.0444	0.1165	0.0221	0.0961	0.5013	0.4987	1.0000		
BOSTON IMMIGRANT EMPLOYEES	55	11	29	5	24	124	124	248		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
IMMIGRANT RENTER EMPLOYEES	34	9	23	4	15	84	68	151		
RENTER EMPLOYEES/HOUSEHOLD	1.40	1.40	1.40	1.40	1.40			1.40		
BOSTON RENTER HOUSEHOLDS	24	6	16	3	11	60	48	108		
IMMIGRANT OWNER EMPLOYEES	31	5	13	3	13	65	75	140		
OWNER EMPLOYEES/HOUSEHOLD	1.25	1.25	1.25	1.25	1.25			1.25		
BOSTON OWNER HOUSEHOLDS	25	4	10	2	11	52	60	112		

*FRACTIONS OF TOTAL EMPLOYMENT FROM CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY

TOTAL BOSTON RENTERS	81	17	39	6	23	166	314	480
TOTAL BOSTON OWNERS	67	8	18	5	20	118	288	406

TABLE A-3
PROJECT IMPACT
Zero Diplacement Factor

Total additional owners/renters due to the project (using Herr assumptions on employment and Cambridge Systematics 1987 survey)

	Boston	Back Bay w/Charles	South End	Kenmore, Fenway	Mis.Hill LwrRoxy	Rest of Boston	Total Impact Area
Inmigrant Households:							
Owner	406	67	20	26	5	288	118
Renter	480	81	23	56	6	314	166
Assuming that additional workers inmigrate over the 5 yr period Annual additions to house-seekers:							
Owner	81	13	4	5	1	58	24
Renter	96	16	5	11	1	63	33
Assuming that the available rental units include 20% of condos Owner units include all owner occupied and 80% of condos							
Rental Impact:							
Year 1:	0.69%	0.80%	0.68%	0.67%	0.26%	0.69%	0.69%
Year 2:	0.67%	0.78%	0.65%	0.67%	0.25%	0.67%	0.67%
Year 3:	0.66%	0.78%	0.64%	0.67%	0.25%	0.66%	0.67%
Year 4:	0.66%	0.78%	0.63%	0.67%	0.25%	0.66%	0.67%
Year 5:	0.66%	0.77%	0.63%	0.67%	0.25%	0.65%	0.67%
Total:	3.3%	3.9%	3.2%	3.3%	1.3%	3.3%	3.4%
Owner Impact:							
Year 1:	0.47%	0.62%	0.44%	0.51%	0.32%	0.45%	0.53%
Year 2:	0.44%	0.58%	0.39%	0.48%	0.30%	0.42%	0.50%
Year 3:	0.43%	0.55%	0.38%	0.46%	0.30%	0.42%	0.47%
Year 4:	0.42%	0.53%	0.37%	0.44%	0.30%	0.41%	0.46%
Year 5:	0.42%	0.51%	0.36%	0.42%	0.29%	0.41%	0.44%
Total:	2.2%	2.8%	1.9%	2.3%	1.5%	2.1%	2.4%

TABLE A-4

Estimated Distributions of Immigrant Employees and Households

1 Employee Per Household

IMPACT AREAS (BY ZIPCODE ASSOCIATIONS)

	BACK BAY	KENMORE	MEDCTR	ROXBURY	SOUTH	IMPACT AREA	REST OF BOSTON	TOTAL BOSTON	OUTSIDE BOSTON	TOTAL
	02108	W. FENS	E. FENS	Xing	END					
ZIPCODES	02116,99	02215		02120	02118		02101-13		ALL OTHER	
	1/2 02114		3/4 OF				1/2 02114		ZIPCODES	
	1/4 02115		02115				19-37,02210			
OFFICE:										
FRACTION OF TOTAL EMPL.*	0.0316	0.0049	0.0103	0.0020	0.0069	0.0557	0.1571	0.2128	0.7851	0.9979
BOSTON FRACTION, TOT EMPL.	0.1485	0.0230	0.0484	0.0094	0.0324	0.2617	0.7383	1.0000		
BOSTON INMIGRANT EMPLOYERS	106	16	35	7	23	187	526	713		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
INMIGRANT RENTER EMPLOYERS	66	13	27	4	14	124	311	435		
RENTER EMPLOYERS/HODSEHOLD	1.0	1.0	1.0	1.0	1.0		1.0	1.0		
BOSTON RENTER HOUSEHOLDS	66	13	27	4	14	124	311	435		
INMIGRANT OWNER EMPLOYERS	40	4	8	2	9	62	216	278		
OWNER EMPLOYERS/HOUSEHOLD	1.00	1.00	1.00	1.00	1.00		1.00	1.00		
BOSTON OWNER HOUSEHOLDS	40	4	8	2	9	62	216	278		
RETAIL:										
FRACTION OF TOTAL EMPL.*	0.0937	0.0187	0.0491	0.0093	0.0405	0.2113	0.2102	0.4215	0.5794	1.0009
BOSTON FRACTION, TOT EMPL.	0.2223	0.0444	0.1165	0.0221	0.0961	0.5013	0.4987	1.0000		
BOSTON INMIGRANT EMPLOYERS	33	7	17	3	14	75	74	149		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
INMIGRANT RENTER EMPLOYERS	21	5	14	2	9	50	41	91		
RENTER EMPLOYERS/HOUSEHOLD	1.00	1.00	1.00	1.00	1.00		1.00	1.00		
BOSTON RENTER HOUSEHOLDS	21	5	14	2	9	50	41	91		
INMIGRANT OWNER EMPLOYERS	13	1	4	1	5	24	34	58		
OWNER EMPLOYERS/HOUSEHOLD	1.00	1.00	1.00	1.00	1.00		1.00	1.00		
BOSTON OWNER HOUSEHOLDS	13	1	4	1	5	24	34	58		

*FRACTIONS OF TOTAL EMPLOYMENT FROM CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY

TOTAL BOSTON RENTERS	86	18	40	7	23	174	351	526
TOTAL BOSTON OWNERS	53	5	11	3	14	87	249	336

TOTAL OWNERS AND RENTERS: 862

TABLE A-5
PROJECT IMPACTS
1 Employee Per Household

otal additional owners/renters due to the project (using Herr assumptions on employment and Cambridge Systematics 1987 survey)

	Boston	Back Bay w/Charles	South End	Kenmore, Fenway	Mis.Hill LwrRoxy	Rest of Boston	Total Impact Area
nmigrant Households:							
wner	336	53	14	16	3	250	86
enter	526	86	23	58	7	352	174
ssuming that additional workers inmigrate over the 5 yr period nnual additions to house-seekers:							
wner	67	11	3	3	1	50	17
enter	105	17	5	12	1	70	35
ental Impact:							
994:	0.76%	0.85%	0.68%	0.69%	0.30%	0.78%	0.72%
995:	0.74%	0.84%	0.65%	0.69%	0.30%	0.76%	0.71%
996:	0.74%	0.83%	0.65%	0.69%	0.30%	0.75%	0.71%
997:	0.73%	0.83%	0.64%	0.69%	0.30%	0.75%	0.70%
998:	0.73%	0.82%	0.63%	0.70%	0.30%	0.74%	0.70%
otal:	3.7%	4.2%	3.2%	3.5%	1.5%	3.8%	3.5%
wner Impact:							
994:	0.39%	0.49%	0.31%	0.32%	0.19%	0.39%	0.39%
995:	0.37%	0.46%	0.27%	0.29%	0.18%	0.37%	0.36%
996:	0.36%	0.43%	0.26%	0.28%	0.18%	0.36%	0.35%
997:	0.35%	0.42%	0.26%	0.27%	0.18%	0.36%	0.33%
998:	0.34%	0.40%	0.25%	0.26%	0.18%	0.35%	0.32%
otal:	1.8%	2.2%	1.3%	1.4%	0.9%	1.8%	1.8%

TABLE A-6

Estimated Distributions of Immigrant Employees and Households

1.4 Employee Per Household

IMPACT AREAS (BY ZIPCODE ASSOCIATIONS)

	BACK BAY	KENMORE	MEDCTR	ROXBURY	SOUTH	IMPACT	REST OF	TOTAL	OUTSIDE	
	02108	W. FENS	E. FENS	Xing	END	AREA	BOSTON	BOSTON	BOSTON	TOTAL
ZIPCODES	02116,99	02215		02120	02118		02101-13		ALL OTHER	
	1/2 02114		3/4 OF				1/2 02114		ZIPCODES	
	1/4 02115		02115				19-37,02210			
OFFICE:										
FRACTION OF TOTAL EMPL.*	0.0316	0.0049	0.0103	0.0020	0.0069	0.0557	0.1571	0.2128	0.7851	0.9979
BOSTON FRACTION, TOT EMPL.	0.1485	0.0230	0.0484	0.0094	0.0324	0.2617	0.7383	1.0000		
BOSTON INMIGRANT EMPLOYEES	106	16	35	7	23	187	526	713		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
INMIGRANT RENTER EMPLOYEES	66	13	27	4	14	124	311	435		
RENTER EMPLOYEES/HOUSEHOLD	1.4	1.4	1.4	1.4	1.4		1.4	1.4		
BOSTON RENTER HOUSEHOLDS	47	9	19	3	10	89	222	311		
INMIGRANT OWNER EMPLOYEES	40	4	8	2	9	62	216	278		
OWNER EMPLOYEES/HOUSEHOLD	1.4	1.4	1.4	1.4	1.4		1.4	1.4		
BOSTON OWNER HOUSEHOLDS	29	3	5	2	6	45	154	199		
RETAIL:										
FRACTION OF TOTAL EMPL.*	0.0937	0.0187	0.0491	0.0093	0.0405	0.2113	0.2102	0.4215	0.5794	1.0009
BOSTON FRACTION, TOT EMPL.	0.2223	0.0444	0.1165	0.0221	0.0961	0.5013	0.4987	1.0000		
BOSTON INMIGRANT EMPLOYEES	33	7	17	3	14	75	74	149		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
INMIGRANT RENTER EMPLOYEES	21	5	14	2	9	50	41	91		
RENTER EMPLOYEES/HOUSEHOLD	1.4	1.4	1.4	1.4	1.4		1.4	1.4		
BOSTON RENTER HOUSEHOLDS	15	4	10	2	6	36	29	65		
INMIGRANT OWNER EMPLOYEES	13	1	4	1	5	24	34	58		
OWNER EMPLOYEES/HOUSEHOLD	1.4	1.4	1.4	1.4	1.4		1.4	1.4		
BOSTON OWNER HOUSEHOLDS	9	1	3	1	4	17	24	41		

*FRACTIONS OF TOTAL EMPLOYMENT FROM CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY

TOTAL BOSTON RENTERS	62	13	29	5	17	125	251	375
TOTAL BOSTON OWNERS	38	4	8	2	10	62	178	240

TOTAL OWNERS AND RENTERS: 615

TABLE A-7
PROJECT IMPACTS
1.4 Employee Per Household

Total additional owners/renters due to the project (using Herr assumptions on employment and Cambridge Systematics 1987 survey)

	Boston	Back Bay w/Charles	South End	Kenmore, Fenway	Mis.Hill LwrRoxy	Rest of Boston	Total Impact Area
Inmigrant Households:							
Owner	240	38	10	12	2	178	62
Renter	375	62	17	42	5	249	126
Assuming that additional workers inmigrate over the 5 yr period Annual additions to house-seekers:							
Owner	48	8	2	2	0	36	12
Renter	75	12	3	8	1	50	25
Rental Impact:							
1994:	0.54%	0.61%	0.50%	0.50%	0.22%	0.55%	0.52%
1995:	0.53%	0.60%	0.48%	0.50%	0.21%	0.54%	0.51%
1996:	0.53%	0.60%	0.48%	0.50%	0.21%	0.53%	0.51%
1997:	0.52%	0.59%	0.47%	0.50%	0.21%	0.53%	0.51%
1998:	0.52%	0.59%	0.47%	0.50%	0.21%	0.53%	0.51%
Total:	2.6%	3.0%	2.4%	2.5%	1.1%	2.7%	2.6%
Owner Impact:							
1994:	0.28%	0.35%	0.22%	0.24%	0.13%	0.28%	0.28%
1995:	0.26%	0.33%	0.20%	0.22%	0.12%	0.26%	0.26%
1996:	0.26%	0.31%	0.19%	0.21%	0.12%	0.26%	0.25%
1997:	0.25%	0.30%	0.18%	0.20%	0.12%	0.25%	0.24%
1998:	0.25%	0.29%	0.18%	0.19%	0.12%	0.25%	0.23%
Total:	1.3%	1.6%	1.0%	1.1%	0.6%	1.3%	1.3%

TABLE A-8

PRUDENTIAL REDEVELOPMENT HOUSING IMPACT ESTIMATES: EMPLOYMENT-RELATED DEMAND

No Indirect Employment Effects

	OFFICE	RETAIL	HOUSING	TOTAL	SOURCE
GROSS RENTABLE AREA (SF)	935,000	241,000	372,000	1,548,000	PROJECT NOTIFICATION FORM
AREA/EMPLOYEE	213	306			PHIL HERR, "PNF REPORT FRAGMENTS," APRIL 15,
ON-SITE NEW EMPLOYEES	4,390	788		5,177	
DISPLACEMENT JOBS FACTOR	0.100	0.400			PHIL HERR
DISPLACEMENT JOBS	439	315		754	
NET JOBS ADDED	3,951	472		4,423	
INDIRECT EMPLOYMENT GENERATION:					
BUSINESS PURCHASE JOBS FACTOR	0.000	0.000			HERR
BUSINESS PURCHASE JOBS	0	0		0	
EMPLOYEE PURCHASE JOBS FACTOR	0.000	0.000			HERR
EMPLOYEE PURCHASE JOBS	0	0		0	
ATTRACTED JOBS (AGGLOMERATION) FACTO	0.000	0.000			HERR
ATTRACTED JOBS	0	0		0	
TOTAL JOBS GENERATED	3,951	472		4,423	
FRACTION BOSTON RESIDENTS	0.213	0.422			CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY
NUMBER BOSTON RESIDENT JOBS	842	199		1,041	
JOBS OF PREVIOUSLY UNEMPLOYED FACTOR	0.064	0.087			HERR
JOBS OF PREVIOUSLY UNEMPLOYED	54	17		72	
ADDED WORKERS NOT PREVIOUSLY IN LABOR FORCE, FACTOR	0.064	0.101			HERR
ADDED WORKERS NOT PREV. IN LABOR FOR	54	20		74	
FORMER OUTCOMMUTERS FACTOR	0.234	0.215			HERR
FORMER OUTCOMMUTERS	197	43		239	
NET BOSTON IMMIGRANT EMPLOYEES	536	119		656	

TABLE A-9

Estimated Distributions of Immigrant Employees and Households

No Indirect Employment Effects

	IMPACT AREAS (BY ZIPCODE ASSOCIATIONS)									
	BACK BAY 02108	KENMORE W. FENS 02215	MEDCTR E. FENS	ROXBURY Xing 02120	SOUTH END 02118	IMPACT AREA	REST OF BOSTON	TOTAL BOSTON	OUTSIDE BOSTON	TOTAL
ZIPCODES	02116,99 1/2 02114 1/4 02115		3/4 OF 02115				02101-13 1/2 02114 19-37,02210		ALL OTHER ZIPCODES	
OFFICE:										
FRACTION OF TOTAL EMPL.*	0.0316	0.0049	0.0103	0.0020	0.0069	0.0557	0.1571	0.2128	0.7851	0.9979
BOSTON FRACTION, TOT EMPL.	0.1485	0.0230	0.0484	0.0094	0.0324	0.2617	0.7383	1.0000		
BOSTON INMIGRANT EMPLOYEES	80	12	26	5	17	140	140	536		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
INMIGRANT RENTER EMPLOYEES	49	10	20	3	11	93	234	327		
RENTER EMPLOYEES/HOUSEHOLD	1.3	1.3	1.3	1.3	1.3			1.3		
BOSTON RENTER HOUSEHOLDS	38	7	16	3	8	72	180	252		
INMIGRANT OWNER EMPLOYEES	30	3	6	2	7	47	162	209		
OWNER EMPLOYEES/HOUSEHOLD	1.05	1.05	1.05	1.05	1.05			1.05		
BOSTON OWNER HOUSEHOLDS	29	3	5	2	6	45	155	199		
RETAIL:										
FRACTION OF TOTAL EMPL.*	0.0937	0.0187	0.0491	0.0093	0.0405	0.2113	0.2102	0.4215	0.5794	1.0009
BOSTON FRACTION, TOT EMPL.	0.2223	0.0444	0.1165	0.0221	0.0961	0.5013	0.4987	1.0000		
BOSTON INMIGRANT EMPLOYEES	26	5	14	3	11	60	60	119		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
INMIGRANT RENTER EMPLOYEES	16	4	11	2	7	40	32	73		
RENTER EMPLOYEES/HOUSEHOLD	1.3	1.3	1.3	1.3	1.3			1.3		
BOSTON RENTER HOUSEHOLDS	13	3	8	1	5	31	25	56		
INMIGRANT OWNER EMPLOYEES	10	1	3	1	4	19	27	46		
OWNER EMPLOYEES/HOUSEHOLD	1.05	1.05	1.05	1.05	1.05			1.05		
BOSTON OWNER HOUSEHOLDS	10	1	3	1	4	19	26	44		

*FRACTIONS OF TOTAL EMPLOYMENT FROM CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY

TOTAL BOSTON RENTERS	51	11	24	4	14	103	205	308
TOTAL BOSTON OWNERS	38	4	8	2	10	63	180	243

TOTAL OWNERS AND RENTERS: 551

TABLE A-10
PROJECT IMPACTS
No Indirect Employment Effects

Total additional owners/renters due to the project (using Herr assumptions on employment and Cambridge Systematics 1987 survey)

	Boston	Back Bay w/Charles	South End	Kenmore, Fenway	Mis.Hill LwrRoxy	Rest of Boston	Total Impact Area
Inmigrant Households:							
Owner	243	38	10	12	2	181	62
Renter	308	51	14	35	4	204	104
Assuming that additional workers inmigrate over the 5 yr period Annual additions to house-seekers:							
Owner	49	8	2	2	0	36	12
Renter	62	10	3	7	1	41	21
Rental Impact:							
Year 1:	0.44%	0.50%	0.41%	0.42%	0.17%	0.45%	0.43%
Year 2:	0.43%	0.50%	0.40%	0.42%	0.17%	0.44%	0.42%
Year 3:	0.43%	0.49%	0.39%	0.42%	0.17%	0.44%	0.42%
Year 4:	0.43%	0.49%	0.39%	0.42%	0.17%	0.43%	0.42%
Year 5:	0.43%	0.49%	0.38%	0.42%	0.17%	0.43%	0.42%
Total:	2.2%	2.5%	2.0%	2.1%	0.9%	2.2%	2.1%
Owner Impact:							
Year 1:	0.28%	0.35%	0.22%	0.24%	0.13%	0.28%	0.28%
Year 2:	0.26%	0.33%	0.20%	0.22%	0.12%	0.27%	0.26%
Year 3:	0.26%	0.31%	0.19%	0.21%	0.12%	0.26%	0.25%
Year 4:	0.25%	0.30%	0.18%	0.20%	0.12%	0.26%	0.24%
Year 5:	0.25%	0.29%	0.18%	0.19%	0.12%	0.26%	0.23%
Total:	1.3%	1.6%	1.0%	1.1%	0.6%	1.3%	1.3%

TABLE A-11

PRUDENTIAL REDEVELOPMENT HOUSING IMPACT ESTIMATES: EMPLOYMENT-RELATED DEMAND

Sensitivity Analysis 1, Increasing Immigration

	OFFICE	RETAIL	HOUSING	TOTAL	SOURCE
GROSS RENTABLE AREA (SF)	935,000	241,000	372,000	1,548,000	PROJECT NOTIFICATION FORM
AREA/EMPLOYEE	213	306			PHIL HERR, "PRU REPORT FRAGMENTS," APRIL 15,
ON-SITE NEW EMPLOYEES	4,390	788		5,177	
DISPLACEMENT JOBS FACTOR	0.075	0.300			Down 25%
DISPLACEMENT JOBS	329	236		565	
NET JOBS ADDED	4,060	551		4,612	
INDIRECT EMPLOYMENT GENERATION:					
BUSINESS PURCHASE JOBS FACTOR	0.225	0.126			Up 25%
BUSINESS PURCHASE JOBS	914	69		983	
EMPLOYEE PURCHASE JOBS FACTOR	0.063	0.063			Up 25%
EMPLOYEE PURCHASE JOBS	254	34		288	
ATTRACTED JOBS (AGGLOMERATION) FACTO	0.125	0.125			Up 25%
ATTRACTED JOBS	508	69		576	
TOTAL JOBS GENERATED	5,735	724		6,460	
FRACTION BOSTON RESIDENTS	0.213	0.422			CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY
NUMBER BOSTON RESIDENT JOBS	1,222	306		1,527	
JOBS OF PREVIOUSLY UNEMPLOYED FACTOR	0.048	0.065			Down 25%
JOBS OF PREVIOUSLY UNEMPLOYED	59	20		79	
ADDED WORKERS NOT PREVIOUSLY IN LABOR FORCE, FACTOR	0.048	0.076			Down 25%
ADDED WORKERS NOT PREV. IN LABOR FOR	59	23		82	
FORMER OUTCOMMUTERS FACTOR	0.176	0.161			Down 25%
FORMER OUTCOMMUTERS	214	49		264	
NET BOSTON IMMIGRANT EMPLOYEES	890	213		1,103	

TABLE A-12

Estimated Distribution of Immigrant Employees and Households

Sensitivity Analysis 1

	IMPACT AREAS (BY ZIPCODE ASSOCIATIONS)									
	BACK BAY 02108	KENMORE W. FENS	MEDCTR E. FENS	ROXBURY Xing	SOUTH END	IMPACT AREA	REST OF BOSTON	TOTAL BOSTON	OUTSIDE BOSTON	TOTAL
ZIPCODES	02116,99 1/2 02114 1/4 02115	02215	3/4 OF 02115	02120	02118		02101-13 1/2 02114 19-37,02210		ALL OTHER ZIPCODES	
OFFICE:										
FRACTION OF TOTAL EMPL.*	0.0316	0.0049	0.0103	0.0020	0.0069	0.0557	0.1571	0.2128	0.7851	0.9979
BOSTON FRACTION, TOT EMPL.	0.1485	0.0230	0.0484	0.0094	0.0324	0.2617	0.7383	1.0000		
BOSTON IMMIGRANT EMPLOYEES	132	20	43	8	29	233	657	890		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
IMMIGRANT RENTER EMPLOYEES	82	16	34	6	18	155	388	543		
RENTER EMPLOYEES/HOUSEHOLD	1.3	1.3	1.3	1.3	1.3			1.3		
BOSTON RENTER HOUSEHOLDS	63	12	26	4	14	119	298	418		
IMMIGRANT OWNER EMPLOYEES	50	5	9	3	11	78	269	347		
OWNER EMPLOYEES/HOUSEHOLD	1.05	1.05	1.05	1.05	1.05			1.05		
BOSTON OWNER HOUSEHOLDS	48	4	9	3	10	74	256	331		
RETAIL:										
FRACTION OF TOTAL EMPL.*	0.0937	0.0187	0.0491	0.0093	0.0405	0.2113	0.2102	0.4215	0.5794	1.0009
BOSTON FRACTION, TOT EMPL.	0.2223	0.0444	0.1165	0.0221	0.0961	0.5013	0.4987	1.5013		
BOSTON IMMIGRANT EMPLOYEES	47	9	25	5	20	107	106	213		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
IMMIGRANT RENTER EMPLOYEES	29	7	19	3	13	72	58	130		
RENTER EMPLOYEES/HOUSEHOLD	1.40	1.40	1.40	1.40	1.40			1.40		
BOSTON RENTER HOUSEHOLDS	21	5	14	2	9	51	41	93		
IMMIGRANT OWNER EMPLOYEES	18	2	5	2	8	35	48	83		
OWNER EMPLOYEES/HOUSEHOLD	1.25	1.25	1.25	1.25	1.25			1.25		
BOSTON OWNER HOUSEHOLDS	14	2	4	1	6	28	39	67		

*FRACTIONS OF TOTAL EMPLOYMENT FROM CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY

TOTAL BOSTON RENTERS	84	18	40	7	23	171	340	511
TOTAL BOSTON OWNERS	62	6	13	4	17	102	295	397

TOTAL OWNERS AND RENTERS: 908

TABLE A-13
Sensitivity Analysis 1,
Increases in Jobs

	Boston	Back Bay w/Charles	South End	Kenmore, Fenway	Mis.Hill LwrRoxy	Rest of Boston	Total Impact Area
nmigrant Households:							
wner	397	62	17	19	4	295	102
enter	511	84	23	58	7	339	172
ssuming that additional workers inmigrate over the 5 yr period							
nnual additions to house-seekers:							
wner	79	12	3	4	1	59	20
enter	102	17	5	12	1	68	34
ental Impact:							
ear 1:	0.74%	0.83%	0.68%	0.69%	0.30%	0.75%	0.71%
ear 2:	0.72%	0.82%	0.65%	0.69%	0.30%	0.73%	0.70%
ear 3:	0.72%	0.81%	0.65%	0.69%	0.30%	0.73%	0.70%
ear 4:	0.71%	0.81%	0.64%	0.69%	0.30%	0.72%	0.70%
ear 5:	0.71%	0.80%	0.63%	0.70%	0.30%	0.72%	0.69%
otal:	3.6%	4.1%	3.2%	3.5%	1.5%	3.6%	3.5%
wner Impact:							
ear 1:	0.46%	0.57%	0.37%	0.37%	0.25%	0.46%	0.46%
ear 2:	0.43%	0.54%	0.33%	0.35%	0.24%	0.43%	0.43%
ear 3:	0.42%	0.51%	0.32%	0.33%	0.24%	0.43%	0.41%
ear 4:	0.41%	0.49%	0.31%	0.32%	0.24%	0.42%	0.40%
ear 5:	0.41%	0.47%	0.30%	0.31%	0.24%	0.42%	0.38%
otal:	2.1%	2.6%	1.6%	1.7%	1.2%	2.2%	2.1%

TABLE A-14

PRUDENTIAL REDEVELOPMENT HOUSING IMPACT ESTIMATES: EMPLOYMENT-RELATED DEMAND

Sensitivity Analysis 2, Decreasing Immigration

	OFFICE	RETAIL	HOUSING	TOTAL	SOURCE
GROSS RENTABLE AREA (SF)	935,000	241,000	372,000	1,548,000	PROJECT NOTIFICATION FORM
AREA/EMPLOYEE	213	306			PHIL HERR, "PNF REPORT FRAGMENTS," APRIL 15,
ON-SITE NEW EMPLOYEES	4,390	788		5,177	
DISPLACEMENT JOBS FACTOR	0.125	0.500			Up 25%
DISPLACEMENT JOBS	549	394		942	
NET JOBS ADDED	3,841	394		4,235	
INDIRECT EMPLOYMENT GENERATION:					
BUSINESS PURCHASE JOBS FACTOR	0.135	0.076			Down 25%
BUSINESS PURCHASE JOBS	519	30		548	
EMPLOYEE PURCHASE JOBS FACTOR	0.038	0.038			Down 25%
EMPLOYEE PURCHASE JOBS	144	15		159	
ATTRACTED JOBS (AGGLOMERATION) FACTO	0.075	0.075			Down 25%
ATTRACTED JOBS	288	30		318	
TOTAL JOBS GENERATED	4,792	468		5,260	
FRACTION BOSTON RESIDENTS	0.213	0.422			CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY
NUMBER BOSTON RESIDENT JOBS	1,021	197		1,218	
JOBS OF PREVIOUSLY UNEMPLOYED FACTOR	0.080	0.109			Up 25%
JOBS OF PREVIOUSLY UNEMPLOYED	82	21		103	
ADDED WORKERS NOT PREVIOUSLY IN LABOR FORCE, FACTOR	0.080	0.126			Up 25%
ADDED WORKERS NOT PREV. IN LABOR FOR	82	25		107	
FORMER OUTCOMMUTERS FACTOR	0.293	0.269			Up 25%
FORMER OUTCOMMUTERS	299	53		353	
NET BOSTON IMMIGRANT EMPLOYEES	558	98		656	

TABLE A-15

Estimated Distribution of Immigrant Employees and Households

Sensitivity Analysis 2

	IMPACT AREAS (BY ZIPCODE ASSOCIATIONS)									
	BACK BAY 02108	KENMORE W. FENS	MEDCTR E. FENS	ROXBURY Xing	SOUTH END	IMPACT AREA	REST OF BOSTON	TOTAL BOSTON	OUTSIDE BOSTON	TOTAL
ZIPCODES	02116,99 1/2 02114 1/4 02115	02215	3/4 OF 02115	02120	02118		02101-13 1/2 02114 19-37,02210		ALL OTHER ZIPCODES	
OFFICE:										
FRACTION OF TOTAL EMPL.*	0.0316	0.0049	0.0103	0.0020	0.0069	0.0557	0.1571	0.2128	0.7851	0.9979
BOSTON FRACTION, TOT EMPL.	0.1485	0.0230	0.0484	0.0094	0.0324	0.2617	0.7383	1.0000		
BOSTON IMMIGRANT EMPLOYEES	83	13	27	5	18	146	412	558		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61	FROM BRA NEIGHBORH	
IMMIGRANT RENTER EMPLOYEES	51	10	21	4	11	97	243	340		
RENTER EMPLOYEES/HOUSEHOLD	1.3	1.3	1.3	1.3	1.3			1.3		
BOSTON RENTER HOUSEHOLDS	40	8	16	3	9	75	187	262		
IMMIGRANT OWNER EMPLOYEES	31	3	6	2	7	49	169	218		
OWNER EMPLOYEES/HOUSEHOLD	1.05	1.05	1.05	1.05	1.05			1.05		
BOSTON OWNER HOUSEHOLDS	30	3	6	2	7	47	161	207		
RETAIL:										
FRACTION OF TOTAL EMPL.*	0.0937	0.0187	0.0491	0.0093	0.0405	0.2113	0.2102	0.4215	0.5794	1.0009
BOSTON FRACTION, TOT EMPL.	0.2223	0.0444	0.1165	0.0221	0.0961	0.5013	0.4987	1.0000		
BOSTON IMMIGRANT EMPLOYEES	22	4	11	2	9	49	49	98		
NBHD RENTER/OWNER FRACTION	0.62	0.78	0.78	0.67	0.62			0.61		
IMMIGRANT RENTER EMPLOYEES	14	3	9	1	6	33	27	60		
RENTER EMPLOYEES/HOUSEHOLD	1.40	1.40	1.40	1.40	1.40			1.40		
BOSTON RENTER HOUSEHOLDS	10	2	6	1	4	24	19	43		
IMMIGRANT OWNER EMPLOYEES	8	1	3	1	4	16	22	38		
OWNER EMPLOYEES/HOUSEHOLD	1.25	1.25	1.25	1.25	1.25			1.25		
BOSTON OWNER HOUSEHOLDS	7	1	2	1	3	13	18	31		

*FRACTIONS OF TOTAL EMPLOYMENT FROM CAMBRIDGE SYSTEMATICS 1987 PRU CENTER SURVEY

TOTAL BOSTON RENTERS	49	10	23	4	13	98	206	304
TOTAL BOSTON OWNERS	37	3	8	2	9	59	178	238

TOTAL OWNERS AND RENTERS: 542

TABLE A-16
PROJECT IMPACT
Factors Decreasing Jobs

	Boston	Back Bay w/Charles	South End	Kenmore, Fenway	Mis.Hill LwrRoxy	Rest of Boston	Total Impact Area
Inmigrant Households:							
Owner	238	37	9	11	2	179	59
Renter	304	49	13	33	4	205	99
Assuming that additional workers inmigrate over the 5 yr period Annual additions to house-seekers:							
Owner	48	7	2	2	0	36	12
Renter	61	10	3	7	1	41	20
Rental Impact:							
Year 1:	0.44%	0.48%	0.38%	0.40%	0.17%	0.45%	0.41%
Year 2:	0.43%	0.48%	0.37%	0.39%	0.17%	0.44%	0.40%
Year 3:	0.43%	0.47%	0.37%	0.39%	0.17%	0.44%	0.40%
Year 4:	0.42%	0.47%	0.36%	0.40%	0.17%	0.44%	0.40%
Year 5:	0.42%	0.47%	0.36%	0.40%	0.17%	0.43%	0.40%
Total:	2.1%	2.4%	1.8%	2.0%	0.9%	2.2%	2.0%
Owner Impact:							
Year 1:	0.28%	0.34%	0.20%	0.22%	0.13%	0.28%	0.27%
Year 2:	0.26%	0.32%	0.18%	0.20%	0.12%	0.26%	0.25%
Year 3:	0.25%	0.30%	0.17%	0.19%	0.12%	0.26%	0.24%
Year 4:	0.25%	0.29%	0.16%	0.19%	0.12%	0.26%	0.23%
Year 5:	0.24%	0.28%	0.16%	0.18%	0.12%	0.25%	0.22%
Total:	1.3%	1.5%	0.9%	1.0%	0.6%	1.3%	1.2%

APPENDIX 2

Example of Calculation Methodology

APPENDIX 2

To illustrate exactly how impacts are measured, it is useful to follow an example for one neighborhood. We will show for the South End neighborhood how the results are calculated, going through all steps, including added demand, added supply, and the impacts caused by the interaction between the two.

Demand:

Table 2-1 shows the employment generated increase in demand for housing as a result of the Prudential Center Redevelopment. Of the 862 expected inmigrants (713 office and 149 retail), 37 (23 office and 14 retail) are expected to seek housing in the South End (Table 2-2). The total number of employees expected to move to the neighborhood is calculated based on the distribution of office and retail workers in the current Prudential Center using the 1987 Cambridge Systematics Survey. 3.2 percent of current Prudential Center office workers who live in Boston reside in the South End as do 9.6 percent of retail workers who live in Boston.

The distribution of inmigrants between owner and renter tenure is assumed to be the same as the tenure distribution for current neighborhood residents. The BRA 1988 profile of the South End neighborhood shows that 62 percent of South End residents are renters. The number of employees per household is determined based on office/retail and owner/renter status, where owner occupants and office workers are expected to have fewer Prudential employees per household than renters and retail workers. We expect that the mix of 23 office workers and 14 retail workers Redevelopment will bring 13 new owners and 17 new renters into the South End.

Supply:

Table 3-1 shows the 1987 housing supply for all neighborhoods in the city. The South End had 1650 traditional owner units, 2300 condos and 5200 rental units, of which 1050 were rent controlled. Table 3-1 also shows the 1994 housing stock, which was calculated using the 1987 stock as a base, taking into consideration new construction, condo conversions and rent control.

The BRA lists of developments in the neighborhood, show that an expected 116 new owner units and 78 new rental units will be added each year (Table 3-2).

Between 1980 and 1987 approximately 30 percent of the 1980 private rental stock was lost due to conversions to condominiums, an average rate of 4.88 percent of the stock per year. If we assume that the conversion rate will be half its current rate,

2.44 percent of what is left from the 1987 stock will be converted each year. Thus 826 units will be lost to the private rental stock from 1988 through 1994

(5200-[(1-0.024)**7]*5200]),

leaving 4374 units at the end of 1994; 107 units will be lost in 1995, or

(.0244*4374), leaving 4267;

104 units in 1996, or

(0.0244*4267);

etc. (Table 3-3).

The rent controlled stock in the South End has been decreasing at an annual rate of 9.37 percent since vacancy decontrol was enacted in 1976. Thus, of the 1050 currently controlled units in the South End, it is expected that 527

{[(1-0.0937)**7]*1050},

will still be rent controlled in 1994, 478

[(1-0.0937)*527]

in 1995, etc. (Table 3-4).

Turnover rates are based on the distribution of neighborhood residents by length of tenure, as reported in the BRA neighborhood profiles. The neighborhood profile gives a single distribution for owners and renters combined. Owners tend to stay in units longer than renters, so these neighborhood numbers were adjusted by citywide differences between owners and renters, which were calculated using 1981 Annual Housing Survey data for Boston. Thus, it is anticipated that 43.7 percent of rental units and 19.1 percent of owner units in the South End change hands each year. (For the city as a whole, an average of 39.6 percent of rental units and 17.3 percent of owner units change hands each year). (See Table 3-5).

Table 3-7 shows the owner and renter stock available to inmigrants and other housing seekers each year. In calculating the stock available to inmigrants each year, we assume that:

- All new construction is available in that year. For other units, only the portion that turns over is available.
- Rent controlled and subsidized units are not part of the available stock.
- Twenty percent of condominiums are rented out.
- All new construction of owner occupied stock is condominiums.

Thus, the available owner stock in 1994 is:

0.1907 x [1650 + 0.8 x (2300+826+815)] = 0.1907 x 4803 = 916

where:

0.1907	=	owner turnover
1650	=	1987 traditional owner stock
0.8	=	share of condos available to inmigrant owners (20% of condos are assumed to be rented)
2300	=	1987 condo stock
826	=	condo conversion 1987-1994
815	=	new construction of condos 1987-1994

The stock available to owners in 1995 is:

$$0.1907 \times (4803 + 0.8 \times 107) + 0.8 \times 116 = 1025$$

where:

107	=	condo conversions in 1995
116	=	annual new construction in all available (except 20% which are rented out)

The stock available to owners in 1996 is:

$$0.1907 \times [4803 + 0.8 \times (107+104+116)] + 0.8 \times 116 = 1059$$

where:

104	=	condo conversions in 1996
116	=	annual new construction. 1995 construction available at turnover rates, 1996 construction all available (except 20% which are rented out).

The stock available to renters in 1994 is:

$$0.4366 \times [5200 - (0.8 \times 826) + 0.2 \times (2300 + 815) - 527 + 543]$$
$$= 0.4366 \times [5178] = 2261$$

where:

0.4366	=	renter turnover
5200	=	1987 rental stock
0.8	=	share of conversions lost to renters
826	=	condo conversion 1987-1994
0.2	=	share of condos available to renters
2300	=	1987 condo stock
815	=	construction of new condos 1987-1994
527	=	rent control stock in 1994
543	=	new construction of rental units 1987-1994

The stock available to renters in 1995 is:

$$0.4366 \times (5178 - 0.8 \times 107 - 478) + 78 + 0.2 \times 116 + 49 = 2374$$

where:

107	=	conversions in 1995
116	=	construction of new condos each year
478	=	controlled units in 1995
78	=	construction of rental units each year
49	=	units vacancy decontrolled in 1995 (=527 - 478)

The stock available to renters in 1996 is:

$$0.4366 \times [5178 - 0.8 \times (107 + 104) + 49 + 0.2 \times 116 + 78] + 78 + 0.2 \times 116 + 45 = 2399$$

where:

104	=	conversions in 1996
433	=	controlled units in 1996
116	=	new condos constructed each year. Of those constructed in 1995, 20 percent of all units constructed in 1996 are available.
78	=	new rental units constructed each year. Of those constructed in 1995, units are available at the turnover rate, while all units constructed in 1996 are available.

Impacts:

Since we assume that 17 renter households and 13 owner households will move to the South End over the 5 year period, each year, 3.4 renter and 2.6 owner households will move into the neighborhood as a result of the project. Thus, the anticipated rent and price increases in 1994 are:

Rents: $(3.4/2261)/0.3 = 0.5\%$

where:

3.4	=	added households
2261	=	available rental units
0.3	=	relation between added demand and price (from the renter price elasticity of demand)

Prices: $(2.7/916)/1 = 0.29\%$

where:

2.7	=	added owner households
916	=	available units
1	=	relation between added demand and price (from the owner price elasticity of demand)

ADDENDA TO HOUSING IMPACT REPORT

The PruPAC Housing Subcommittee was actively involved in the development of the "Comprehensive Housing Impact Report." They participated in the selection of the housing consultant, interviewing several candidates and voting to choose Abt Associates. From August, 1988 to January, 1989, they met to discuss the assumptions upon which the study would be based, and to review and comment on Abt Associates' work-in-progress and draft reports.

In the course of discussions about the final report, a number of issues were raised by members of the Housing Subcommittee. These comments are addressed in the following pages.

ADDENDA TO HOUSING IMPACT REPORT:

RESPONSES TO PRUPAC COMMENTS MADE ABOUT THE HOUSING REPORT AT THE JANUARY 3, 1989 PRUPAC HOUSING SUBCOMMITTEE MEETING.

1. COMMENT: Median rents and condo prices should be $800/mo and $190,000 respectively, to reflect figures in BRA's "Boston Housing Facts and Figures" report.

   RESPONSE: Table 4-2 computes the percentage change for rents ranging from $300 to $800. The $190,000 figure is the median price for Boston condominiums of 2 bedrooms or more in 1987. The median price for ALL condominiums in Boston was $145,000 in 1987, according to the report.

2. COMMENT: On page 9, total outcommuters should add to 314 instead of 315.

   RESPONSE: 315 is actually more accurate, because it reflects the addition of two numbers which include values beyond the decimal point which are not displayed in the computer printout, but which affect the result when the numbers are used for mathematical operations. Because the entire employment-related demand part of the study is basically a mathematical model, the most precise results are obtained by not rounding until the final answer.

3. COMMENT: The equation on page 12 which calculates the percentage of new employees to live in the impact area should read: (.056 x 5264 + .211 x 591) / 5845.

   RESPONSE: This is correct but the result, when rounded to one decimal point, is the same: 7.2%.

4. COMMENT: On page 20, the percentage of condominiums which are rented out is 20%. A Greater Boston Real Estate Board survey suggests this figure is closer to 50%.

   RESPONSE: Both Jim Wallace and John Avault of the BRA Research Department think that 20% is a more appropriate number for rental of condominiums in 1994. Both conclude that two factors, the softening of the condo market, and changes in the tax laws, will discourage those investors who have heretofor rented out condo units.

5. COMMENT: On page 35, the last sentence in the third complete paragraph should read, "This translates to an increase in monthly rent in the first year. . . ".

   RESPONSE: Agreed.

6. COMMENT: 1) On page 38, the discussion in the third and second to last paragraph is referring to the phenomena of employment-related demand, not induced demand; 2) the selection of 20% as the degree of Copley induced demand Prudential will generate is not sufficiently substantiated.

RESPONSE: 1) This appears to be a digression into employment-related demand. However its part in the larger subjective argument that Prudential's induced impact will be equal to 20% of that of Copley is not critical; 2) the 20% is a subjective judgement of the consultant. It bears noting that if one were to assume that it was 100%, the result would be a 1.3% impact in prices; if it were 50%, the impact on prices would be .65%, and so on. The consultant does not quantify the impacts of induced demand on rental rates, but states that in principle the impact should be lower than on ownership housing.

7. COMMENT: On page 40, the ratio of 82-84 prices to 85-87 prices for (Back Bay + South End - Copley), 1.814, appears mathematically inconsistent with the two ratios for Back Bay and South End individually, 1.770 and 1.704, respectively (since it is higher than either of the two).

RESPONSE: The ratio for (Back Bay + South End - Copley), 1.814, is computed by dividing the average 85-87 price by the average 82-84 price (the ratio heading should read "ratio 85-87/82-84"). In other words, the ratio measures by how much the units appreciated between 82-84 and 85-87. The individual Back Bay and South End figures each included some of the Copley units which were then taken out for the (Back Bay + South End - Copley) number. Because the Copley units did not appreciate as much as either the Back Bay or the South End (this is evident in the line graph on the following page, p. 41), removing these units makes the average unit appreciate more, which makes the ratio of 85-87 price to 82-84 price higher for (Back Bay + South End - Copley).

COMMENT: The response to the comment regarding page 40 states that "because the Copley units did not appreciate as much as either the Back Bay or the South End units (this is evident in the line graph on the following page, page 41), removing these units makes the average rent appreciate more, which makes the ratio of 85-87 price to 82-84 price higher for (Back Bay + South End - Copley)." While it is true that the **price amount** changed less in the Copley units than in the South End and Back Bay units, the **percentage change** is greater for the Copley units as noted in Table 4-3 (1.86 as compared to 1.70 and 1.77). If the Copley units included in the Back Bay and South End figures had a similar

percentage increase as those listed separately, then removing them for the (Back Bay + South End - Copley) (i.e. removing a higher number from a lower number) would have the effect of decreasing, not increasing, the number. In fact, had those Copley units not been included in the individual South End and Back Bay figures, their Iratio number would have been even lower. On the other hand, the Copley units included in the South End and Back Bay units may have had a smaller percentage increase than the Copley units which are listed separately. If that is the case, then the result could have been as stated in Table 4-3.

8. COMMENT: In Table 4-3 the second figure in the "Total" column should be 119,000 not 177,000.

RESPONSE: Agreed.

PRUDENTIAL CENTER REDEVELOPMENT

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Volume VIII: Public Benefits

VIII

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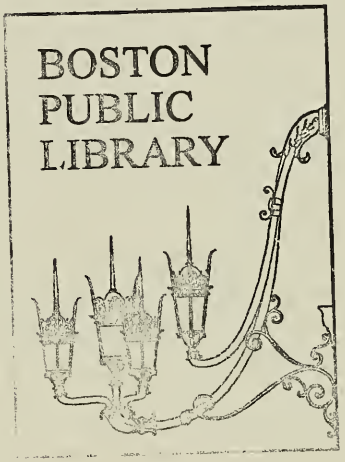
PRUDENTIAL CENTER REDEVELOPMENT

DRAFT PROJECT AND ENVIRONMENTAL IMPACT REPORT
Volume VIII: Public Benefits

VIII



April 12 1989

submitted to:
The Boston Redevelopment Authority
Massachusetts Executive Office of Environmental Affairs
Executive Office of Environmental Affairs Number: 7208

submitted by:
The Prudential Property Company, Inc.
for The Prudential Insurance Company of America

Carr, Lynch, Hack and Sandell
Goodwin, Procter &Hoar
Philip B. Herr Associates
HMM Associates
Langley Keyes
Vanasse Hangen Brustlin, Inc.

DRAFT PROJECT AND ENVIRONMENTAL IMPACT REPORT

PROJECT

Prudential Center Redevelopment
Boston, Massachusetts

DEVELOPER

The Prudential Property Company, Inc., for The Prudential Insurance Company of America

STATUS OF PROJECT

The developer submitted a Project Notification Form to the Boston Redevelopment Authority (BRA) and an Environmental Notification Form to the Massachusetts Executive Office of Environmental Affairs (EOEA) on June 29, 1988. Scoping letters were issued to the developer by the BRA and EOEA on September 1, 1988. The EOEA number is 7208. The project is in pre-schematic design stage. Master plan approval is being sought.

BRIEF DESCRIPTION OF THE PROJECT

The project includes the addition of new offices, retail spaces and housing to the current Prudential Center site. New housing and offices, with retail uses at their base, will be constructed principally along the Boylston Street, Huntington Avenue and Belvidere Street frontages. The current retail area will be reconstructed and expanded with indoor pedestrian passageways. Enclosed pedestrian routes will provide connections between Boylston Street and Huntington Avenue, and between Copley Place and the south entrance of the Hynes Convention Center. A system of public squares, a wintergarden and outdoor open spaces will be created as amenities for those using the center and adjacent neighbors. A neighborhood commercial area, including an expanded supermarket, is proposed for Huntington Avenue and East Ring Road. East Ring Road will be improved to facilitate pedestrian flows to the shopping area. The existing parking garages will remain approximately the same size, but their capacity will be expanded by approximately 800 spaces through changes to their management.

ALTERNATIVES CONSIDERED

Two basic planning approaches have been considered for the site, and for each three scales of building program have been analyzed. Alternative A proposes two new office structures along Huntington and principally housing, with a small office structure, along Boylston. Alternative A2 has housing as well as offices along Huntington Avenue and housing, along with expanded offices, along Boylston Street. The form of structures, their heights, and the organization of pedestrian routes also vary between these two basic alternatives. Alternatives B and B2 are similar in configuration, respectively, to Alternatives A and A2, but the overall development totals 10 percent less area. Alternatives C and C2 follow the same outlines, but are 20 percent smaller in area than Alternatives A and A2. In the course of preparing these plans, a large number of other design and functional alternatives were considered and rejected as less desirable.

DEVELOPMENT PROGRAM

The three basic levels of program studied are, as follows:
(000 FAR gross sq. ft.)

Use	Alternatives A and A2	Alternatives B and B2	Alternatives C and C2
Offices	1,009	865	811
Residential	404	378	324
Retail	268*	210*	160*
Total Areas	**1,681**	**1,448**	**1,295**
Plus Indoor Pedestrian Areas	153**	153**	103**
TOTAL PROGRAM	**1,834**	**1,601**	**1,398**

* In addition, 143,000 gross sq. ft. of existing retail is demolished and rebuilt.

** Areas vary slightly between alternatives.

DEVELOPMENT SCHEDULE

The project is planned as a number of separate phases to be completed over a 10 year period. Construction will begin on the south side of the site, moving to the north. Phases along Huntington Avenue should be completed by 1994, with the Boylston Street area completed by 1999.

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IA: Summary Appendix
II: Urban Design Alternatives
III: Transportation Access Plan
IIIA: Transportation Access Plan Appendix
IV: Environmental Impacts
V: Wind Impacts
VA: Wind Impacts Appendix
VI: Infrastructure Systems
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PRUDENTIAL CENTER REDEVELOPMENT

DRAFT PROJECT AND ENVIRONMENTAL IMPACT REPORT
VOLUME VIII: PUBLIC BENEFITS

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1. PUBLIC BENEFITS

1.1 Public Benefits Summary

Fiscal Benefits

- o Average increase in annual tax benefits to the City - $9.3 million
- o New annual sales and meals taxes - $1.6 million
- o New state annual income taxes - $6.1 million

Jobs Benefits

- o Jobs linkage funds - $1.3 million
- o 2200 construction jobs
- o Total construction earnings - $118.7 million
- o 5600 permanent jobs
- o Annual permanent employment salaries - $154 million
- o Aggressive program for recruiting Boston residents, minorities and women

Housing Benefits

- o Linkage - $6.6 million
- o Market rate condominium housing - approximately 300 units
- o Additional Voluntary housing contribution - $1.1 million

Public Amenities

Urban Design

- o Improved integration of Prudential Center into its context
- o Improved pedestrian connections to surrounding neighborhoods
- o Better defined Huntington Avenue st eet edge
- o Scale and massing responsive to the site's surroundings

Open Space

- o Boylston Street and Huntington Avenue streetscape improvements
- o Redesigned open spaces with increased plantings and seating
- o Wintergarden with year-round performance area

- Significantly upgraded East Ring Road
- Comfortable and lively pedestrian passageways

Public Use Benefits

- Expanded supermarket
- Two childcare centers with outdoor play areas
- Chapel
- Post office
- New neighborhood shopping area
- Greater Boston Convention and Tourist Bureau Information Center

Transportation and Transit Improvements

- Public Transportation Improvements
  - Improved access to area transit stations
- Parking Management Improvements
  - Coordination with the MCCA to assist in providing additional off-site parking for the Hynes Convention Center
  - Overnight parking for area residents at reduced rates
  - Handicapped parking throughout the garage
- Access/circulation design improvements
  - Upgraded Boylston Street frontage replacing North Ring Road
  - Widened Huntington Avenue at Belvidere and West Newton Streets
  - A parking enforcement presence on East Ring Road
- Loading Improvements
  - Delivery time restrictions
- Pedestrian improvements
  - Upgraded pedestrian connections to public transportation facilities
  - Additional pedestrian warning signs at garage entrances and exits
  - Upgraded pedestrian lighting and improved handicapped access

Infrastructure Improvements

- Improvements to the Boston Water and Sewer Commission (BWSC) distribution network
- Major improvements to the sewer and storm drain system
- Significant measures to conserve electrical energy and steam

1.2 Background

Prudential has a long history of providing benefits to the City of Boston. In the 1950's, when the development of the Prudential Center was first proposed, the site was occupied by abandoned railroad yards and Boston was in the depths of economic decline. A risky endeavor, it represented a major investment in the future of the city, and was hailed as a catalyst for resurgence of the downtown. Since that time, the Prudential Center has offered jobs, housing, parking and neighborhood retail space. In addition, Prudential has provided for major transportation projects within its boundaries including rights of way for the Massachusetts Turnpike Extension and the MBTA Green Line Prudential Station.

More recently, the Prudential Center has continued its role as a responsible neighbor, providing a multitude of benefits to the city and nearby neighborhoods. Since 1986, Prudential has contributed approximately $4.8 million in socially responsible commitments. This includes nearly $1.8 million in community grants and activities, a $2 million investment in the Boston Housing Partnership II project and $1 million in public use rent subsidies, as outlined below.

These benefits include contributions to facilities, affordable housing, planning efforts and neighborhood services. Recently, Prudential was supportive of the expansion of the Hynes Convention Center at some cost of disruption to its commercial complex. It has recently added a child care center to help meet the needs of the neighborhood. It has long provided over 10,000 square feet of space significantly below market rate for the Greater Boston Convention and Tourist Bureau and for a chapel within its commercial complex.

Prudential has been among the most active local corporations in assisting affordable housing efforts, recently purchasing two of the sixteen partnership units required for the Boston Housing Partnership II project. This contribution of $2 million will assist in the renovation of 939 low and moderate income rental units.

Prudential has also made significant contributions in dollars and time toward area planning studies and civic improvements, including $75,000 to the Back Bay Area Transportation Study, $80,000 to the Boylston Streetscape Design, and $250,000 to the Copley Square Centennial Committee for capital costs in reconstructing the square.

In the area of neighborhood services, Prudential contributed significantly ($300,000 in kind and cash contribution) to the Morgan Memorial Goodwill Industries capital campaign. Prudential initiated "Pickin' Up the Neighborhood" in 1986, a neighborhood clean-up program since adopted by the city, and has contributed $134,000 to that effort. Prudential supports a broad range of social service programs each year, including "Failure to Thrive," a program aimed at children who because of poverty and stress do not grow at an expected rate, and several organizations assisting the homeless such as the Long Island Shelter, the Pine Street Inn and Rosie's Place.

The redevelopment of the Prudential Center will provide an opportunity for Prudential to continue and to expand its role in providing benefits to the City of Boston and its residents in several important ways. The Prudential Center Redevelopment Project will generate a series of public benefits, over and above the value of a renewed and better designed Prudential Center. These include fiscal benefits, jobs benefits, housing opportunities, public amenities and public infrastructure and transportation improvements.

The level of public benefits will vary in response to the level of development on site. As the development program is scaled down from Alternative A to Alternatives B or C, the revenues generated from the redevelopment are reduced and correspondingly the resources available for public benefits are diminished. The summary of public benefits presented above assumes the Alternative A level of development on the site.

2. FISCAL BENEFITS

2.1 Real Estate Taxes

Prudential is currently the second largest taxpayer in the City of Boston. The City of Boston will receive a significant increase in annual property tax revenues as a result of the redevelopment of the Prudential Center. The existing Prudential Center currently makes payments under Chapter 121A equivalent to the amount of property taxes which it would pay if it were subject to normal taxes under Chapter 59 (the state law governing local property taxes).

Prudential intends to amend the Chapter 121A Agreement in order to permit the redevelopment to proceed and yet retain the Chapter 121A protections for the tenants of the existing residential buildings. Thus, in the future the project will be taxed partially under the Chapter 121A tax agreement and partially under Chapter 59. The result will be greater tax revenues for the city than if Prudential Center remained entirely under Chapter 121A or entirely under Chapter 59.

The City will also receive additional income as a result of the real estate taxes on the new development under Chapter 59. In the most recent tax year the Prudential Center paid $8.6 million in Chapter 121A payments. The tax benefits to the city would materialize in stages as the redevelopment of the Prudential Center proceeds, starting in fiscal year 1991. If none of the proposed changes to the Center were made, the city could expect to collect approximately $151 million in taxes between fiscal years 1991 and 2001. With redevelopment at the magnitude of Alternative A or A2, the city should collect approximately $244 million over the same time period, an increase of more than 60 per cent. This represents an increase in tax benefits of approximately $93 million over that decade, or an average of $9.3 million per year over that period.

2.2 Municipal Service Costs

In contrast, the additional increase in the annual cost to the City of Boston to service the redeveloped Prudential Center would be about $800,000 per year under Alternative A, or about $600,000 under Alternative C.

The cost to the City of Boston to service the Prudential Center Redevelopment consists of school costs and non-school service costs. Citywide, public school enrollment equals

about 0.25 pupils per dwelling unit. For central area multifamily dwellings, the number is lower. The number of pupils per unit differs consistently among dwelling types. Units of the type proposed would house one public school pupil per 14 or so dwelling units, or about 20 pupils in all. After crediting state aid and a proportionate share of non-tax revenues, the 1987 school cost per pupil was about $4,200, so the school cost of this development would be about $80,000 per year in 1987 dollars.

Costs for public works, health, MBTA charges, and other non-school services in 1987 averaged about $560 per housing unit and $300 per 1,000 gross square feet of non-residential floor area. (See Table 1) calculations derived from 1987 data entered into the IMP impact analysis model used by Herr Associates.) For development of mixed high-rise office and retail use, an average cost of about $380 per 1,000 square feet would be expected, reflecting higher than average service demands.

Table 1: Municipal Cost Variables

Item	Figure
Base Year	1987
Study Year	1989
Inflation Rate	4%
Public School Pupils/Unit	
Citywide Average	0.25
Citywide Elevator	0.07
Net School Cost/Pupil	$4,200
Non-School Cost	
Per Housing Unit	$560
Per 1,000 S.F.	$380

Floor area is FAR gross floor area of non-residential space.
Source: See text.

Added service costs for the Prudential development are presumably close to those averages. This means a non-school service cost of $168,000 for the residences and $485,000 for the businesses under Alternative A (1987 dollars). (See Table 2.) Inflating costs to 1989 dollars, the total annual service cost for the Prudential Center would be expected to increase

to about $800,000 under the A Alternatives, or about $600,000 under Alternative C2. Thus, upon completion, for approximately every additional $1.00 in service costs to the city, the redevelopment will provide an increase in property tax revenues to the city of approximately $12.00.

Table 2: Project Service Cost Analysis

	PROGRAM ALTERNATIVES					
	A	A2	B	B2	C	C2
PROGRAMMED CONSTRUCTION						
Housing Units	300	300	281	232	240	200
Non-residential S.F.	1,276,900	1,279,989	1,070,500	1,090,921	970,900	980,446
SCHOOL COSTS						
Public School Pupils	21	21	20	16	17	14
Public School Cost	$88,200	$88,200	$82,600	$68,200	$70,600	$58,800
NON-SCHOOL COSTS						
Residential	$168,000	$168,000	$157,400	$129,900	$134,400	$112,000
Non-residential	$485,200	$486,400	$406,800	$414,500	$368,900	$372,600
PROJECT TOTAL SERVICE COST						
Total Cost (1987 $)	$741,400	$742,600	$646,800	$612,600	$573,900	$543,400
Assumed Inflation	4%	4%	4%	4%	4%	4%
Total Cost (1989 $)	$801,900	$803,200	$699,600	$662,600	$620,700	$587,700

Source: Calculations from earlier tables.

Table 3 compares the increased annual fiscal benefit to the city as a result of the redevelopment, with the costs to provide public services to the Prudential Center.

Table 3: Fiscal Impacts Upon Completion of Redevelopment

All figures represent incremental new revenues or costs in 1989 dollars (million).

Program	Annual Property Tax Revenues* on Average	Annual Service Costs to City	Annual Retail Sales Taxes (State)	Annual Income Taxes (State)
Alternative A	$ 9.3	$ 0.8	$ 1.6	$ 6.1
Alternative B	$ 8.4	$ 0.7	$ 1.2	$ 5.1
Alternative C	$ 7.5	$ 0.6	$ 0.9	$ 4.8

* Includes combined effect of 121A amendment and new development.

2.3 Sales and Meals Taxes

The redevelopment of the Prudential Center will generate a significant increase in retail sales taxes. The primary new retail areas measure between 391,100 for Alternative A and 287,000 square feet of gross leasable area, for Alternative C, (both figures include reconstruction of 136,200 square feet of gross leasable area of existing retail area). Included will be the Food Court, comparison shopping, business service areas and the neighborhood commercial area around the expanded supermarket. The three office buildings and two residential buildings will also have associated retail areas.

About 88% of the newly constructed retail gross leasable areas will generate retail sales. The other 12% will contain non-retail uses, such as community and financial services, that will not generate sales or meals taxes. Lord & Taylor and Saks Fifth Avenue, which total 235,000 of the Center's present 416,000 square feet of retail space, will be retained.

The redevelopment is likely to enhance retail sales even among current tenants for several reasons. The redesign will create pedestrian ways and outdoor spaces that provide a more active and inviting context for retail uses. The perimeters of the Center will also contain retail uses on the ground level, connecting the Prudential Center's retail tenants much more closely with pedestrian traffic from the Back Bay and South End than is presently the case.

In addition, redevelopment of the Center will result in an expanded number of permanent jobs on the site, estimated at 5,600 for Alternative A. These new jobs and their potential purchasing power are in addition to the approximately 10,000 jobs presently at the Center.

As a result, retail sales in the newly constructed areas are expected to average $250 per square foot in 1989 dollars. Retail sales presently total about $86 million. In 1989 dollars, sales at the redeveloped Prudential Center under Alternative A are expected to total about $140 million, an increase of over $50 million attributable to the redevelopment project. Under Alternative B, retail sales are expected to be about $130 million, with an increase of about $40 million over current sales attributable to the project. Under Alternative C retail sales are likely to total about $118 million, an increase of about $28 million over current retail sales at the Center.

Sales tax revenue at the redeveloped Prudential Center can be estimated as a percentage of retail sales. The percent used, 3.2%, is based on statewide aggregated figures for 1982, the latest year for which retail sales are available for the state from the Census of Retail Trade (U.S. Department of Commerce, Bureau of the Census), compared with state Sales and Meals Tax receipts (Massachusetts Department of Revenue). Further refinement of this percentage for the particular mix of retail shops at the Prudential is premature because of the difficulty in predicting the eventual retail development.

Applying the statewide ratio of Sales and Meals Tax collections, 3.2%, to the expected sales at the Prudential, gives a rough estimate of expected taxes between $3.8 million and $4.5 million in 1989 dollars. (See Table 4.) Subtracting from this the estimated Sales and Meals taxes from the present retail areas shows the increase in Sales and Meals taxes as a result of the redevelopment ranging between $1.6 million for Alternative A and

$0.9 million for Alternative C. Alternative B would generate 74 per cent of the taxes generated by Alternative A, while Alternative C would generate only 55 per cent of those generated by Alternative A.

Table 4: Sales & Meals Tax Projections (1989 $)

	PROGRAM ALTERNATIVES					
	A	A2	B	B2	C	C2
PRESENT FACILITIES						
Present Sales (1989 $)	$89,556,000	$89,556,000	$89,556,000	$89,556,000	$89,556,000	$89,556,000
Sales Tax	$2,865,800	$2,865,800	$2,865,800	$2,865,800	$2,865,800	$2,865,800
RETAINED FACILITIES						
Sales (1989 $)	$54,050,000	$54,050,000	$54,050,000	$54,050,000	$54,050,000	$54,050,000
Sales Tax	$1,729,600	$1,729,600	$1,729,600	$1,729,600	$1,729,600	$1,729,600
NEW CONSTRUCTED FACILITIES						
Sales (1989 $)	$86,050,000	$86,050,000	$72,775,000	$77,050,000	$63,250,000	$65,250,000
Sales Tax	$2,753,600	$2,753,600	$2,328,800	$2,465,600	$2,024,000	$2,088,000
TOTAL						
Sales Tax (1989 $)	$4,483,200	$4,483,200	$4,058,400	$4,195,200	$3,753,600	$3,817,600
Project-added Sales Tax	$1,617,400	$1,617,400	$1,192,600	$1,329,400	$887,800	$951,800

Source: Sales tax from Massachusetts Dept. of Revenue & U.S. Census of Retail Trade.
Sales figures from Table 9.

2.4 Income Taxes

With the new jobs created as a result of the redevelopment, (discussed elsewhere in this volume), there is likely to be an increase in annual income taxes collected by the Commonwealth ranging from $4.8 million for Alternative C to $6.1 million for Alternative A. (Income taxes were calculated using an estimator developed by Herr Associates based on state tax rates and a consideration of likely adjustments to income, tested with limited empirical data.)

3. JOBS BENEFITS

Linkage and job impacts of the Prudential Center Redevelopment were analyzed for six program alternatives as shown in Table 5. The FAR gross square feet for the alternatives ranges from 1,824,500 square feet for Alternative A down to 1,438,050 square feet for Alternative C. All of the alternatives include 142,800 square feet of FAR gross square feet (or 136,000 square feet of gross leasable area) of existing retail space that will be demolished and reconstructed.

Table 5: Programmed Construction

	PROGRAM ALTERNATIVES					
	A	A2	B	B2	C	C2
OFFICE						
FAR Gross Floor Area	1,009,100	1,011,105	865,116	865,116	811,046	811,046
RETAIL *						
FAR Gross Floor Area	410,600	411,684	348,184	368,605	302,654	312,200
Gross Leaseable Area	391,100	391,100	330,775	350,175	287,521	296,590
Demolish Existing GLA	136,000	136,000	136,000	136,000	136,000	136,000
Net Added GLA	255,100	255,100	194,775	214,175	151,521	160,590
TOTAL NON-RESIDENTIAL CONSTRUCTION						
FAR Gross Floor Area	1,419,700	1,422,789	1,213,300	1,233,721	1,113,700	1,123,246
RESIDENTIAL						
FAR Gross Floor Area	404,800	396,261	378,389	372,826	324,350	319,565
TOTAL CONSTRUCTION						
FAR Gross Floor Area	1,824,500	1,819,050	1,591,689	1,606,547	1,438,050	1,442,811

* Each alternative includes 142,800 S.F. of FAR gross floor area, or 136,000 S.F. of gross leaseable area, replacing demolished space.

? -- includes enclosed pedestrian areas in total non-residential FAR grosses.

3.1 Construction Jobs

Construction of the Prudential Center Redevelopment will occur in two stages and continue over approximately a seven to ten year period, beginning in early 1990. Thus, this project will offer a stable source of jobs in the construction industry for a significant length of time.

The areas along Huntington Avenue, Belvidere Street and East Ring Road will be redeveloped in Phases 1 through 4 (Stage 1), and the areas along Boylston Street will be developed in the latter three phases (Stage 2). (See Figure 1.)

For Alternatives A, B, and C, the elements in Stage 1 include the new retail uses lining the pedestrian way from the Copley Place bridge, retail areas on the south side of the site, the neighborhood retail center including an expanded grocery store, the food court, and the two office buildings. The latter phase (Stage 2) would involve retail areas, two or more residential buildings, and an office building. The schedule must be flexible enough to adjust to market conditions, so these phases may not necessarily occur sequentially. With this phasing, construction activity is anticipated to be fairly even over the entire period. Although the construction schedule would likely be the same for each alternative, Alternatives A2, B2, and C2 have a somewhat different configuration.

The amount of construction employment to be generated by the Prudential Center Redevelopment will vary among the types of space being constructed. For this analysis, following construction job estimators are used: 1.5 worker-years per 1000 square feet of office; 0.7 worker-years per 1000 square feet of retail; and 1.0 worker-years per 1000 square feet of residential. (Source: Herr Associates estimates as reported in Evaluating Development Impacts, P. Herr et al, MIT Laboratory of Architecture and Planning, 10/78, Table 5-1, p. 92.) These estimates were corroborated by comparison with estimates being used by other recent developments in the City of Boston.

Figure 1: Alternative A - Phasing Plan

The number of construction worker-years likely to be generated by the Prudential Center Redevelopment is 2,200 for Alternatives A and A2, 1,900 for Alternatives B and B2, and 1,700 for Alternatives C and C2. (Table 6) In accordance with the Boston Residents Construction Employment Plan, that will mean over 1,100 worker-years of employment for Boston residents under Alternatives A and A2, 550 worker-years for minorities, and 220 worker-years for women. There would be 950 worker-years of employment for Boston residents under Alternatives B and B2, and 850 worker-years of employment for Boston residents under Alternatives C and C2.

Table 6: Construction Jobs and Earnings (1989 $)

	PROGRAM ALTERNATIVES					
	A	A2	B	B2	C	C2
OFFICE						
Office Floor Area	1,009,100	1,011,105	865,116	865,116	811,046	811,046
Worker-Years	1,500	1,500	1,300	1,300	1,200	1,200
Project Total Earnings	$81,300,000	$81,300,000	$70,460,000	$70,460,000	$65,040,000	$65,040,000
RETAIL						
Retail Floor Area	410,600	411,684	348,184	368,605	302,654	312,200
Worker-Years	290	290	240	260	210	220
Project Total Earnings	$15,718,000	$15,718,000	$13,008,000	$14,092,000	$11,382,000	$11,924,000
RESIDENTIAL						
Residential Floor Area	404,800	396,261	378,389	372,826	324,350	319,565
Worker-Years	400	400	380	370	320	320
Project Total Earnings	$21,680,000	$21,680,000	$20,596,000	$20,054,000	$17,344,000	$17,344,000
TOTALS						
Total Floor Area	1,824,500	1,819,050	1,591,689	1,606,547	1,438,050	1,442,811
Worker-Years	2,200	2,200	1,900	1,900	1,700	1,700
Project Total Earnings	$118,698,000	$118,698,000	$104,064,000	$104,606,000	$93,766,000	$94,308,000

All floor areas measured in FAR gross floor area.
Source: Calculations from earlier tables.

Construction Earnings

Construction earnings were calculated using the amount currently paid to a journeyman carpenter in Boston. Hourly earnings are $20.73 in wages, plus $6.38 in benefits, or $27.11 in total earnings. (Source: Building and Construction Trades Council of the Metropolitan District.) A 2,000 hour work year, 50 weeks of employment, would esult in $54,220 in annual earnings. The representative journeyman carpenter's earnings are used because they are approximately in the middle of the pay scale for skilled and unskilled construction workers.

Based on average annual earnings of $54,200, construction of Alternative A or A2 of the Prudential Center Redevelopment would generate close to $118.7 in earnings (in 1989 dollars) for construction workers over the life of the project (See Table 6). Construction of Alternative B or B2 would generate about $104 million, while construction of Alternative C or C2 would generate about $94 million in construction earnings.

In accordance with the Boston Residents Construction Employment Plan, construction of Alternatives A or A2 would generate $59 million in construction earnings for Boston residents. Construction of Alternatives B or B2 would provide about $52 million in construction earnings for Boston residents, and construction of Alternatives C or C2 would provide about $47 million in construction earnings for Boston residents.

Additional construction-related employment will result from off-site employment in fabrication and supply activities supporting on-site construction.

Boston For Boston - Construction Employment Plan

A representative of the developer has already met with the Mayor's Office of Jobs and Community Services (OJCS) to discuss innovative strategies for complying with the city's employment goals. The developer, general contractor and OJCS will design specific strategies for a proactive outreach program to meet the goals of their Boston Residents Construction Employment plan. This will also serve to establish what should be a successful relationship throughout the duration of the project's construction.

Jobs Coordinator

The developer will designate one person to be responsible for implementing the construction jobs policy. The developer will also incorporate in the general construction contract

the Boston Residents Construction Employment Standards. The general contractor will be deemed responsible for implementing all of the affirmative action steps outlined in the Boston Jobs policy ordinance to the extent that they do not conflict with any collective bargaining agreement.

The general contractor will also be responsible for incorporating the Standards in all contracts with subcontractors, holding each responsible for taking all steps to ensure affirmative action. The general contractor and each subcontractor will assign individuals the responsibility for overseeing efforts to comply with the Standards.

The developer will also meet with the contractor at least weekly to assess compliance with the Standards and affirmative action efforts. Within ten days of each meeting, the developer will forward minutes of the meeting to OJCS.

Every effort will be made to work with the general contractor and the subcontractors to meet the City's goals. The developer intends to take a proactive posture in this regard, taking such actions as urging the general contractor to sponsor Boston residents, minorities and women for union apprenticeships. Information on the OJCS's Jobs Bank will be visibly posted on the construction site. The Jobs Bank provides referral, guidance and placement services in the construction trades for Boston residents, minorities and women.

The developer will work closely with OJCS to develop creative strategies for compliance with the City's goals, perhaps targeting some portion of the jobs linkage contribution to training in the building trades, through providers such as the Homebuilders Institute.

The developer, through the Jobs Coordinator, will also encourage the general contractor to establish relationships with organizations focused on MBE/WBE issues, such as the Massachusetts State Office of Minority and Women Business Assistance (S.O.M./W.B.A). Special efforts will be made to advertise construction MBE and WBE business opportunities.

The developer plans to donate a personal computer and consultant time to assist the Office of Compliance. This would contribute to furthering the City's goals not only with regard to the redevelopment of Prudential Center, but city-wide.

3.2 Permanent Jobs

The number of permanent jobs likely to be accommodated by the Prudential Center Redevelopment varies by the number of square feet in each type of building use, either office, retail, or residential. The number of permanent jobs likely to be created for each thousand square feet of FAR gross floor area is shown in Table 7. (Source: Cambridge Systematics, "Employment Impacts of Proposed Prudential Center Development," 9/2/87, Table 5-1, p. 5-2.).

Annual wages for office, retail and residential workers are also shown in Table 7. The figures for 1988 were estimated by Herr Associates based on 1987 wages reported by the Massachusetts Division of Employment Security. Wages for 1989 were assumed to have increased by 4 percent per year for inflation.

Table 7: Permanent Job Estimators (1989 $)

	Permanent Jobs per 1,000 S.F.	Annual Wages 1988 Dollars	Inflation	1989 Dollars
Office	4.67	$28,000	4%	$29,000
Retail	3.26	$18,000	4%	$19,000
Residential	0.06	$18,000	4%	$19,000

All floor areas measured in FAR gross floor area.
Source: See text.

Applying these factors to the floor area in Alternatives A and A2 results in about 5,600 new permanent jobs that are likely to be accommodated by the Prudential Center Redevelopment. (See Table 8.) Alternatives B and B2 are likely to result in 4,700 new permanent jobs, while Alternatives C and C2 are likely to result in 4,300 and new 4,400 permanent jobs, respectively. These figures do not include the 10,000 jobs on the site today.

Table 8: Permanent Jobs Added On-Site (1989 $)

	PROGRAM ALTERNATIVES					
	A	A2	B	B2	C	C2
OFFICE						
Office Floor Area	1,009,100	1,011,105	865,116	865,116	811,046	811,046
Permanent Jobs	4,700	4,700	4,000	4,000	3,800	3,800
Annual Wages	$136,300,000	$136,300,000	$116,000,000	$116,000,000	$110,200,000	$110,200,000
RETAIL						
Retail Floor Area	410,600	411,684	348,184	368,605	302,654	312,200
Demolished Floor Area	142,800	142,800	142,800	142,800	142,800	142,800
Net Added Floor Area	267,800	268,884	205,384	225,805	159,854	169,400
Added Permanent Jobs	900	900	700	700	500	600
Annual Wages	$17,100,000	$17,100,000	$13,300,000	$13,300,000	$9,500,000	$11,400,000
RESIDENTIAL						
Residential Floor Area	404,800	396,261	378,389	372,826	324,350	319,565
Permanent Jobs	24	24	23	22	19	19
Annual Wages	$456,000	$456,000	$437,000	$418,000	$361,000	$361,000
TOTALS						
Total Floor Area	1,824,500	1,819,050	1,591,689	1,606,547	1,438,050	1,442,811
Permanent Jobs	5,600	5,600	4,700	4,700	4,300	4,400
Annual Wages	$153,856,000	$153,856,000	$129,737,000	$129,718,000	$120,061,000	$121,961,000

All floor areas measured in FAR gross floor area.
Source: Calculations from earlier tables.

Note that these figures include building operation and other support personnel, as well as tenant employees. However, they do not reflect a number of indirect impacts. For example, employment in spaces remaining (such as non-demolished retail) will likely be impacted positively by these changes, resulting in added jobs. Secondly, the new businesses and their employees, through their purchases, will support additional jobs off-site within Boston.

For Alternatives A and A2, about 1,600 of the added jobs are likely to be held by Boston residents in the absence of special efforts, with a goal of 2,800 resident-held jobs (50 percent) if the aim of the Employment Plan can be met. Reaching the 50 percent goal of the Employment Plan would create 2,350 permanent jobs for Boston residents under Alternatives B and B2 and about 2150 and 2,200 permanent jobs under Alternatives C and C2, respectively.

Permanent Jobs Earnings

The 5,600 permanent jobs likely to be created under Alternatives A and A2 would result in $153.8 million in annual wages (see Table 8), based on estimated average annual wages for office, retail and residential personnel in 1989, as shown in Table 7. Total annual wages are estimated at $129.7 million for Alternatives B and B2, and about $121 for Alternatives C and C2.

Given the Prudential Center's goal under the Voluntary Employment Opportunity Plan of providing 50 percent of its permanent jobs to Boston residents, about $76.9 million could be paid to Boston residents as annual wages under the A Alternatives. The B Alternatives would provide about $64.9 million in income to Boston residents if the 50 percent goal is reached and the C Alternatives would provide about $60 million in income to Boston residents.

Boston For Boston - Voluntary Employment Plan

The developer will cooperate fully with the Boston Employment Commission to ensure that to the extent possible, permanent jobs at the Prudential Center are made available to Boston residents, minorities and women. As part of that cooperation, the developer will adopt a Voluntary Employment Opportunity Plan which details its good faith efforts to assure that fifty percent (50%) of the employment opportunities created in the Prudential Center will be made available to Boston residents.

The Plan will recognize that most of the new employment opportunities will be created and filled by employers that are tenants of Prudential Center. Thus, the developer will take a leadership stance in providing information to tenants on available employment training and referral sources.

The developer will also aggressively encourage all those providing maintenance, management, security, or similar services whose personnel are permanently assigned to work at the Prudential Center to pursue as a goal the employment of Boston residents for fifty percent of the work force.

A dialogue has already begun with OJCS to begin defining innovative and effective strategies for implementing programs and monitoring the success in this area. The developer's goal is to design programs that promote heightened awareness of career opportunities for Boston residents, minorities and women in Boston in general, and at the Prudential Center in particular, and improve access to opportunities for those individuals by providing support in the areas of training, recruitment and employment placement.

The Prudential Center is a unique development project in terms of the 10,000 jobs at the center today. The developer will seek to persuade existing tenants to voluntarily join in Boston for Boston efforts, in a way that is comparable to new tenants. In encouraging the Boston for Boston program among its tenants, the developer proposes to assist tenants in accessing existing job training and referral networks. The developer will encourage its tenants to access both the OJCS and the Governor's Employment and Training Program to identify resources, referral assistance and information exchange.

The developer is prepared to develop a strategy for implementation and monitoring of efforts to comply with the City's goals. Included will be regular surveys of Prudential Center to determine how many Boston residents, minorities and women were hired in the previous year.

The developer intends to launch an aggressive outreach program aimed at residents of neighborhoods impacted by the redevelopment. One strategy will be to work with community organizations in recruiting employees, such as the Urban League of Eastern Massachusetts, Action for Boston Community Development, Hubert Humphrey Occupational Resource Center, and United South End Settlements. Another strategy would be to locate an employment office on site for Prudential Center jobs.

The developer also intends to use the existing newsletter, "Talk of the Hub" as a vehicle for disseminating employment news, such as training programs, job opportunities, new local hires, recruitment schedules, and employment-related events, such as job fairs.

First Source Agreement

The developer will enter into a First Source Agreement with the City of Boston Office of Jobs and Community Service, which provides that for a specific period of time the Prudential Center will use the job exchange in filling positions for operating, security, maintenance, and management personnel.

Boston Compact and The Private Industry Council

The Prudential Property Company will be a signatory to the Boston Compact, thus committing to give priority in hiring to Boston Public School students and graduates for summer jobs and entry level jobs after graduation. The developer recognizes the seriousness of the high dropout rates in Boston public schools, and is committed to provide increased opportunities for Boston's youth. Thus, the developer will participate in the Private Industry Council's (PIC) summer jobs program. The developer will also consider participation in other PIC programs, such as Boston Works which focuses on training, and Opportunities in Boston which focuses on residents' and minority hiring efforts.

3.3 Jobs Linkage Funds

Under Articles 26, 26A, and 26B of the Boston Zoning Code, the Prudential Center Redevelopment will provide a grant to the Neighborhood Jobs Trust of $1.00 for each square foot of FAR gross square feet of non-residential area in excess of 100,000 gross square feet. Alternative A, with the highest qualifying floor area, will pay a Neighborhood Jobs Trust contribution of $1.3 million. Alternative C, with the lowest qualifying floor area of 1 million square feet will pay a Neighborhood Jobs Trust contribution of $1 million. (Table 9)

Approximately twenty per cent of the contribution is reserved for residents of neighborhoods adjacent to the development. The developer has the option of making a cash contribution over a two year period or using the linkage commitment to create and operate its own job training program for Boston residents to be permanently employed at the project.

Table 9: Job Benefits

All figures represent 1989 dollars (million).

Program	Job Linkage Contributions	Construction Jobs Total Payroll	Permanent Jobs Total Payroll
Alternative A	$ 1.3	$ 119	$ 154
Alternative B	$ 1.1	$ 104	$ 129
Alternative C	$ 1.0	$ 94	$ 118

Jobs Linkage Training Program

Discussions have already begun with the Mayor's Office of Jobs and Community Services to ensure that this significant amount of funding is put to the most creative and effective use possible. While the initial focus for jobs linkage funded programs was on training for specific skills, preliminary discussions with OJCS suggest a trend toward balancing this with a focus on job-related education programs. One potentially promising direction is to combine education and job training in a program oriented toward the City's youth.

Boston, one of the nation's strongest development and job markets had a public high school dropout rate of 45 per cent for its graduating class of 1987 (Source: "Proposed New Goals for the Boston Compact" presented at the B.P.I.C. Annual Meeting, 10/31/88). Preliminary discussions with OJCS confirmed the developer's sense that out-of-school youth are a segment of Boston's population for whom the opportunities inherent in the City's economic health must be made more attainable. The developer plans to continue discussions with OJCS and training and educational service organizations to further develop and explore available options.

In preliminary discussions, several potential elements of a successful program have been identified. The first element involves targeting populations in neighborhoods impacted

by the redevelopment, based on careful assessment of what their employment-related needs are, and how they might best be served. It is the developer's goal to go beyond targeting the mandated twenty per cent to impacted neighborhoods. The Hispanic population in the South End is one population to target for this support, as this group is large and underserved in this regard. In the Fenway/Kenmore area, the sizable Southeast Asian population is an appropriate one to target. Without a great deal of job training capacity now in the South End or the Fenway/Kenmore areas, both would benefit from this heightened attention.

A second element will be contracting with community based service organizations in impacted neighborhoods to provide the educational and job training programs. Particular efforts would be made to solicit the services of non-profit minority and women-owned service organizations. Youth-oriented service organizations to support in the new programs include local ones such as Bridge Over Troubled Waters or Jobs for Youth, Inc. The developer also believes that there may be significant opportunities for collaboration with Hubert Humphrey Occupational Resource Center. Moreover, the Cardinal Cushing Center has both a strong youth education program and strong literacy program, which could be tapped into.

A third element of a successful program will be orienting such training efforts to permanent jobs likely to be created as a result of the redevelopment. This suggests an innovative program design that would maximize the potential for coordination between the jobs linkage training program and permanent job hiring practices on-site. One possibility would be to channel funds to a program to support the needs of a single major tenant, perhaps in a joint venture with a provider such as the Hubert Humphrey Occupational Resource Center.

Whatever the final training program is, every effort will be made to assure community participation by locating it in the area and advertising in neighborhood and ethnic newspapers. With OJCS, the developer will develop a solicitation and selection process for job training providers. The developer also plans to complement the job training efforts with career awareness opportunities, such as tours of buildings and offices. Whatever the program, the developer believes that an important element will be the extent to which the efforts can be institutionalized, and a reputation for success over the years built.

4. HOUSING BENEFITS

4.1 Impacts on Adjacent Communities

In response to the PruPAC's guidelines and the Scoping Determination issued by the BRA, the developer commissioned a comprehensive housing impact study, which is presented in detail in Volume VII: Housing Impacts. The study aimed at estimating the marginal impacts on housing costs -- those incremental effects attributable to the Prudential Center Redevelopment. The effects isolated are in addition to the underlying housing price trends in the areas surrounding the Prudential Center. Two sources of marginal housing impacts were estimated: employment related impacts and induced housing demand impacts.

The results of the study showed that the estimates of employment related housing impacts on any particular neighborhood are likely to be quite small, and relatively similar among neighborhoods. The resultin marginal increases in rents and prices are likely to be less than one per cent annually for units changing hands. These predicted annual impacts are so small that there should be no discernable displacement of current residents as a result of the Prudential redevelopment project. (See Table 10)

Table 10: Housing Price Impacts

Neighborhood	Expected Rent Increase in 1994	Total 5 Year Rent Increase	Expected Price Increase in 1994	Total 5 Year Price Increase
Back Bay Beacon Hill	0.6%	3.1%	0.4%	2.0%
South End	0.5%	2.4%	0.3%	1.2%
Fenway Kenmore	0.5%	2.6%	0.3%	1.6%
Lower Roxbury Mission Hill	0.2%	1.1%	0.2%	0.9%
Total Impact Area	0.5%	2.7%	0.4%	1.6%
Rest of Boston	0.6%	2.9%	0.4%	1.6%
Total Boston	0.6%	2.8%	0.4%	1.6%

The concept of "induced housing demand" proved more difficult to define and measure. As a working definition, induced housing demand was considered to be the marginal increase in demand for housing in the vicinity of the Prudential Center, purely because of a positive change in the perceived attractiveness of living near the Prudential Center after it is redeveloped.

One estimate of the effects of induced housing demand was based on the experience with Copley Place. Inferring similar effects requires two extreme assumptions: that the redevelopment of the Prudential Center will change the attractiveness of areas surrounding it in exactly the same way that the Copley Place development altered the residential attractiveness of its environs; and that all the price increases which occurred on streets adjacent to Copley Place were solely attributable to the induced housing demand stemming from its construction. Under these assumptions, the effect could be an increase in condominium prices by 2.6 percent above the overall Back Bay/South End price trends as a result of the Prudential Center Redevelopment. However, under more plausible assumptions, the housing impacts resulting from induced demand are likely to be significantly less, perhaps less than one per cent, and confined to the few blocks around the Prudential Center.

The conclusions of the housing impact study extend the degrees of freedom for location of housing generated by the linkage requirement and inclusionary policy of the City: efforts to increase affordable housing could occur on a broad basis. Since no one surrounding area is likely to be impacted in a singular way by the redevelopment, affordable housing can be located in terms of perceived opportunities for cost-effective development in surrounding areas and beyond (See Table 10). Affordable housing can be created through new development, rehabilitation or preservation of the existing stock of housing in areas where it is threatened.

4.2 Protections For Existing Residential Tenants

Tenants in the existing Prudential Apartments are currently protected against loss of their units through conversion to condominiums by the fact that any changes to the status of the units would require an amendment to the Chapter 121A agreement for the site. Amendments to such agreements must be approved by the Mayor and the BRA.

Although amendments will be required to the 121A agreement to permit new offices, housing and retail uses to be developed on the site, amendments will affect only current and future office and retail tenants and new housing. The developer has no intention of either amending the agreement to permit conversion of the existing apartments, or terminating the 121A agreement as it applies to the existing apartments.

4.3 Affordable Housing Efforts

Under Articles 26, 26A and 27 of the Boston Zoning Code, the developer will provide linkage contributions for housing of $5.00 for each square foot of FAR gross floor area of non-residential area in excess of 100,000 square feet. Thus the developer would make a housing linkage contribution of $6.6 million for Alternative A, $5.5 million for Alternative B and $5.0 million for Alternative C. (See Table 11).

Table 11: Housing Benefits

All figures represent 1989 dollars (million).

Program	Housing Linkage Contributions	Affordable Housing Contributions	Total	% Reduction
Alternative A	$ 6.6	$ 1.1	7.7	
Alternative B	$ 5.5	$ 1.0	6.5	16%
Alternative C	$ 5.0	$ 0.9	5.9	23%

Extensive discussions among the BRA, the Housing Subcommittee of PruPAC and the developer have produced a list of six critical issues which frame the agenda for the development of an affordable housing program. Two of these issues have been resolved:

1. the new housing to be created on the site will be condominiums;

2. for legal reasons no consideration will be given to use of existing on-site housing as a resource for providing additional affordable housing. (It is worth noting that approximately

forty per cent of the existing apartments are currently protected by the City of Boston rent stabilization laws and offer housing to their occupants at less than half the rate of comparable market units in the same building.)

Four issues require further discussion among the BRA, the PruPAC and the developer:

3. housing benefits in the form of linkage or voluntary contributions, which are related to issues of development phasing and permitting, and to the public costs and benefits of the redevelopment.

4. siting of affordable housing units. Given the unique infrastructure related construction cost premium of developing on the Prudential Center site, the developer believes strongly that the maximum number of affordable housing units can be created by developing them off-site. However, consideration must be given to the trade-off between using housing linkage funds and contributions to subsidize the maximum number of units of off-site affordable housing and the policy goal of including affordable units as part of any new residential development (implied in the PruPAC guidelines).

5. the mechanism by which linkage (and voluntary contribution funds) will be allocated to new, rehabilitated or existing affordable housing.

6. the nature and extent of the Prudential role in the affordable housing program.

Resolution of these last four issues will take place in the course of discussion of this DPIR/EIR. Their resolution will be informed by the continued input of the PruPAC Housing Subcommittee.

Issue 6 represents a major possibility for innovative affordable housing funding. The Prudential Insurance Company of America is a corporate entity involved in a wide range of financing and social investment enterprises. A goal throughout the PruPAC Housing Subcommittee discussion has been to seek ways to engage Prudential beyond the explicit requirement of linkage and a voluntary housing contribution in the process of promoting affordable housing.

The PruPAC Housing Subcommittee has discussed a concept of the corporate model for affordable housing. The model has three sources of funding, here called Pru 1, Pru 2 and Pru 3.

Pru 1

Pru 1 is made up of project-generated linkage funds and the funds made available through a voluntary housing contribution. Housing linkage funds will be required of the developer in proportion to the areas of office and retail uses constructed on the site. These contributions would range between $6.6 million if Alternative A is constructed and $5.1 million if Alternative C is built.

Beyond the legal requirement of linkage funds, the developer has indicated a willingness to voluntarily contribute additional funds for off-site affordable housing in a manner consistent with the recently enacted housing policy contained in The Midtown Cultural District plan. If the Midtown housing formula were applied to the redevelopment of the Prudential Center, it would result in approximately $1.1 million in additional subsidies beyond housing linkage funds. The amount would be approximately $1.0 million with Alternative B or $0.9 million with Alternative C. Table 11 outlines the housing benefits for each of the alternatives.

Pru 2

Prudential is a potential source of below-market rate, long-term investment funds for projects which its social investment committee deems to be appropriate. Recently, this source was tapped to purchase $2 million in investment units for the Boston Housing Partnership II project to assist in the renovation of 939 low and moderate income rental apartments. Prudential is prepared to entertain proposals, whose merits are judged on a case-by-case basis, for social betterment projects or programs including those which would leverage linkage or other funds to create a larger number of affordable units than would otherwise be possible.

Pru 3

Pru 3 assigns a role to Prudential's extensive corporate capacities as a long-term mortgage lender. Pru 3 is not yet assured; there is at present no guarantee that it can be delivered. The developer will continue to work to try to include it as a part of the corporate model.

The object of combining resources in the corporate model is to multiply the effects of efforts and to provide a spectrum of programs that address the affordability gap for households of several levels of income. The precise form of programs and their magnitude and the individual projects to be sponsored must await resolution of the scale of development which will be permitted. Meanwhile, the developer will continue to work closely with the Housing Subcommittee of PruPAC, the BRA and the Mayor's Office in resolving these issues and designing the programs to be supported.

5. PUBLIC AMENITIES

As previously stated, public benefits will be a direct function of the scale of development on site. In regard to public amenities in particular, the reductions are not strictly proportionate since fixed costs (foundations, infrastructure modifications, etc.) are virtually identical for each level of development on the site, and thus the funds available for off-site benefits decrease more sharply with reductions in the development program.

5.1 Urban Design

The Prudential Center today is an example of 1950's planning and design thought. However, time has stood still for the Prudential Center, while the rest of the city has moved successfully into the late twentieth century, elevating Boston to the realm of world class cities. Thus, the timing is propitious for the redesign of the Prudential Center to better meet the needs of residents on-site and in surrounding neighborhoods. This argument is strengthened by the fact that thousands of out-of-town visitors attending events at the new Hynes Convention Center will have the Prudential Center as one of their first and lasting impressions of the city. With the redesign of the Prudential Center, not only will this impression be a better one, but the needs of local workers and residents will be better served.

The proposed redesign will redress many of the problems of the existing Prudential Center, such as its isolation and separation from its context. Enclosure of the network of pedestrian passageways on the site will overcome the unpleasant conditions in the colder months, and their lack of vitality will be remedied by lining both sides with retail uses. Windswept and lifeless open spaces will be replaced by spaces rimmed by activity.

The elimination of the North and South Ring Roads and the creation of street edges on both Boylston Street and Huntington Avenue activated with new retail uses will contribute

to knitting the site into its surroundings, and ameliorating its current inward orientation. Moreover, the abrupt climb to deck level to cross the Turnpike, which currently contributes to the sense of the site's isolation, will be eased through the creation of interior open spaces at mid-level on each side.

Finally, the scale and massing of the new design is responsive to the context on both the Boylston Street and Huntington Avenue sides, with special attention paid to respecting the Christian Science Center.

Knitting the Prudential Center into its Surroundings

A major public benefit in urban design terms, will be achieved by the radical improvements to the way in which the Prudential Center relates to its context. Each of the bordering conditions of the Prudential Center is quite different, demanding custom tailored responses.

Boylston Street is characterized by a diversity in heights and building forms. This demands a response reflecting that richness rather than a street wall of a singular pattern. Extending buildings out to the street along Boylston Street, will create continuous retail frontage all the way to the entrance of the Prudential Center, activating the street and enhancing the pedestrian experience.

In contrast, Huntington Avenue, once the site of urban renewal clearance efforts, today is almost completely a procession of modern buildings. As Huntington Avenue is upgraded, it will become a grand boulevard, linking Copley Square, and ultimately downtown with the concentration of civic and medical institutions in the Fenway.

The Christian Science Center is the centerpiece of the Avenue near Prudential. However, the eastern end of the Christian Science Plaza lacks definition, since buildings on the Prudential site are set back from the street and are positioned according to the Back Bay street axis rather than Huntington Avenue, or South End axis. The awkward relationship of Prudential Center to Huntington Avenue continues across the entire frontage of the site -- there is no sense of street wall, and pedestrians are forced to navigate an obstacle course of entry drives when walking along the street.

By constructing a consistent street wall across this frontage, the Christian Science Plaza would gain definition through the contrast of built to open areas. Moreover, a consistent line of retail uses would encourage pedestrians to walk along the north side of the street, where there is sunlight and protection from the cold northern winds.

While the three development alternatives vary in height and bulk, the typical street wall before stepping back, will be approximately the same height as the Colonnade Hotel and Greenhouse Apartments on the south side of Huntington, in all cases. And it is the street wall which would count most in determining the scale of the street. With a typical building to building street width of 120 feet and a street wall height of 110 feet, the section will fall within the range of comfort for streets which seem enclosed but not canyon-like.

Exeter Street, along the eastern edge of the Prudential site, currently has the character of a service street except near the entrance to the Copley Square Hotel. Circulation patterns at Exeter and Huntington make it extremely difficult for pedestrians to cross to Copley Place at grade. As a result, the pedestrian bridge between Prudential Center and Copley Place and beyond is an important lifeline and deserves to become a "main street" in the plan for a redeveloped Prudential Center.

North-south routes across the Prudential site are equally important. Today a steady stream of pedestrians flows between Boylston and Huntington during almost any hour. On the east side of Prudential Center, pedestrians walking from Boylston Street shops to Copley Place or the South End face a frustrating experience, especially on East Ring Road where sidewalks are discontinuous. The redevelopment will improve the north-south paths, thereby creating a greater sense of connection between the two large neighborhoods directly bordering the site.

Pedestrian Circulation

When the redevelopment is complete, the twenty-seven acre site will be crossed by six major pedestrian ways, as a network allowing pedestrians to travel indoors to each corner of the site and beyond to Copley Place. Two transit stations will be incorporated into this network: the Prudential Green Line Station and the Back Bay Commuter Rail/Orange Line Station reached via Copley Place. Major new public squares will be located at key key pedestrian intersections and where the indoor pedestrian network connects with the surrounding streets.

The pedestrian experience along Boylston will be improved when the entrances to the North Parking Garage have been consolidated into a single curb cut, (located east of Fairfield Street) to prevent exiting automobiles destined for Storrow Drive from using Fairfield Street. Huntington Avenue garage entrances will also be reorganized to eliminate South Ring Road and to create space for both new retail uses facing the street and a generous pedestrian way.

East Ring Road will be extensively improved, allowing pedestrians to travel on both sides of the street and introducing landscape plantings at street level. The reconstruction

of this street will make it hospitable to pedestrians and will smooth the flow of traffic, converting the street into a zone where pedestrians and vehicles are in balance. There will be convenient pulloffs in front of both Saks Fifth Avenue and the new neighborhood center. On the east side of the street, a glass-covered arcade will provide weather protection for pedestrians walking to the neighborhood commercial center, or between Lord & Taylor and Copley Place.

In order to ease the transition from the street level to the deck over the turnpike (typically a vertical change of 20 feet), intermediate levels will be provided at both the Boylston Street and Huntington Avenue entrances. Entering the Prudential Center from Boylston Street, the pedestrian will be protected by the glazed roof, almost 60 feet above the street. Escalators and stairs will lead to an intermediate level, approximately 10 feet above the street, designed as an extension of the street lined by retail spaces.

On the south side of the site, the intermediate level would be more extensive and includes a wintergarden as well as the main passageways. The elevator lobby for the new Huntington Office Building would be located at the intermediate level, adding life to the adjacent space. The intermediate level would be accessible from two directions: via a generous stairway passing under the Belvidere Office Building and by stairs and escalators directly from Huntington. The intermediate level would help signal the presence of open spaces to pedestrians on the bordering streets. The southern terminus of the pedestrian street would also connect via an indoor passageway directly into the Prudential MBTA Station.

Massing and Heights

The facades of the Boylston Street structures will be deliberately broken down in scale to mirror the diversity of the opposite side of the street. To minimize the disruption

of views from the end units in the Fairfield Apartments, a gap will be preserved in the building wall along Boylston, in line with the existing apartments. This would also serve as a secondary pedestrian entrance to the site.

Massing along Huntington Avenue would seek to create a street edge that is in scale with structures along the street. Four other objectives have also had an influence on the massing of structures in this area: 1) the desire to provide a graceful terminus to the Christian Science Plaza; 2) the need to limit heights directly south of the outdoor open space to prevent its shading; 3) the wish to allow the north-south pedestrian way to reach Huntington without passing under buildings; and 4) the necessity of maintaining as large a space as possible between the new Huntington Office Building and the existing 101 Huntington Office structure. After studying dozens of massing possibilities, the arrangement shown was considered the best solution to these somewhat competing objectives.

The new structures will form a street wall approximately 110 feet in height along Huntington, with taller portions stepped back at least 20 feet. For Alternative A, an arcade at the corner of Huntington and Belvidere would provide added width to the pedestrian zone, while maintaining the street wall.

5.2 Open Space

The Prudential's dedication to quality open space is demonstrated by the recent commitment of $250,000 to assist in the redesign of Copley Square. The redeveloped Prudential Center will continue to offer a generous amount of open space for both site users and neighbors,

with 9.5 acres or 35% of the site dedicated to this use. The new plan proposes the creation of a series of new open spaces for public use and enjoyment as well as improvements to existing pedestrian walkways and open spaces.

A major component of the redevelopment project under the full development program (Alternatives A and A2), would be the renewal of each of the open spaces on the site. In addition, new streetscapes would be constructed along Huntington Avenue, Boylston Street, Belvidere and East Ring Road, to integrate the site with its neighborhood.

The current open space south of the Prudential Tower would be enlarged and connected to a new indoor atrium space -- a wintergarden that can be used as a performance and recreation space in all seasons. The wintergarden would be surrounded by new retail uses and two new office structures, sited carefully to allow sunlight to reach the south open space during the midday hours. A renewed open space would remain adjacent to the Boylston and Fairfield Apartments. With new activities and housing added on its north edge, the space would become a residential courtyard, off the major movement routes. On Boylston Street, between the Hynes Auditorium and the new entrance to the Center, a ground level plaza would be created.

The new open space south of the Prudential Tower would be designed as a formal garden, rimmed by terraces for dining and seating. A space for performances, such as noon time concerts, would be located at the base of the tower. Terraced levels would connect the south open space with the intermediate pedestrian level of the wintergarden. In cooler weather, performances would move indoors into this space.

The residential courtyard bounded by the Fairfield and Boylston Apartment buildings and new Boylston Street residential buildings would be transformed into an extensively planted area for the passive enjoyment of the surrounding residents, and during daytime hours, passersby and visitors to the center. New stairways and ramps would make a connection with East Ring Road to allow pedestrians to reach the open space from this direction. A children's play area would be located in a sunny spot between the two existing apartment buildings. Access in the evening to this open space would be exclusively for on-site residents and their guests in the evening hours. New landscaping in the Gloucester courtyard would convert that space into a usable area for the residents of the building and provide a gracious entry near street level. A series of canopies along the east face of East Ring Road would provide cover for pedestrians, while closing the west side of the courtyard.

Sidewalks would be created at street level on both sides of East Ring Road, in keeping with its new function as an important connection between the Back Bay and South End neighborhoods, and the main entrance to the neighborhood shopping area.

The Boylston Street improvements will follow closely the guidelines proposed in the on-going Boylston Streetscape Study. There would be trees located on the curb side of the walk, 30 feet on center, and a 30 foot sidewalk width would provide a generous pedestrian route. The sidewalk would be brick, with grani e curbs, accent bars, and carriage strips; sidewalk materials would continue across curb cuts. The street would be lit by historic fixtures prescribed for the length of Boylston. The new Boylston Plaza is envisioned as a place of gathering and seating for pedestrians from the Hynes Auditorium or Prudential Center, and as a stopping point for pedestrians along the street. A slightly elevated terrace along the face of the Boylston Office Building would create an overlook, and a generous planting of trees would provide a canopy of shade and color.

The proposed Huntington streetscape improvements are aimed at creating a generous pedestrian promenade, accented by a consistent row of street trees where underground conditions permit. Streetscape materials and elements would be similar to those used on Boylston.

Each open space of the complex, including the complete pedestrian network, would be made accessible to the handicapped, through a system of ramps to navigate small grade differences and elevators located near the main entrances. Handicapped areas of the garage would be located near elevators connecting to the deck level.

The hours of access of enclosed pedestrian routes and open spaces will vary according to their purpose:

Main North-South Pedestrian Way	open 24 hours
Copley Place-Sheraton Pedestrian Way	open 24 hours
Wintergarden	open 24 hours
Food Court - Belvidere Route	closed after business hours
North Entrance Lord & Taylor Route	closed after business hours
South Open Space	closed after business hours
Residential Courtyards	access restricted to residents evenings and at night

Open space is one amenity that will vary significantly if less than the full development program is constructed. This is due to the fact that the amount of open space will increase as the development program is reduced, yet at the same time the resources available for public amenities are less. Under Alternative B, the amount of open space will increase slightly as the retail footprint decreases, but the resources for improvement of the spaces

will decline. Thus, a reduction in the quality of materials would be required, including a less expensive roof covering system and more modest pedestrian amenities. Landscape budgets would be trimmed proportionately; the canopy along East Ring Road would be scaled back; and whenever possible, existing landscape materials would be retained.

Alternative C would offer a significantly reduced level of amenities. The effect of the reduced retail program would be considerably larger open space areas at deck and street levels. However, given diminished resources to devote to amenities, a smaller budget would have to be spread over a larger area. In the residential courtyard, current landscaping would be retained, with some additional planters and seating. The enclosed link to Lord & Taylor would be eliminated; an outdoor walkway would replace it. The South Open Space would be significantly larger than in previous plans, but existing walls and landscaping would need to remain. Resources would not permit the enclosure of the wintergarden; hence the South Open Space would become a two-level outdoor space. The central interior open space would need to be smaller. A less costly roof cover system with limited glazing would need to be employed there and in the pedestrian area. The primary streetscape paving materials would need to be concrete in lieu of brick.

5.3 Public Use Benefits

The redeveloped Prudential Center will continue to offer space for a variety of public uses, in addition to open space for public enjoyment. These include a new and significantly expanded supermarket, a better located information center operated by the Greater Boston Convention and Tourism Bureau, a post office and a chapel. Under Alternatives A and B two child care centers with associated outdoor play areas will be provided. Under Alternative C there will be one, as there is currently. Prudential is committed to supporting

these uses, in spite of the fact that their rents are significantly below market rate, because they provide significant public benefits. Moreover a variety of community oriented services and shops will be clustered around the new supermarket and in street level shops, including a pharmacy, bakery and florist.

5.4 Transportation and Transit Improvements

The developer's commitment to improving traffic conditions has been evidenced already in an in-kind and cash contribution of $75,000 to help pay for the Back Bay Area Transportation Study. Recently Prudential committed $30,000 to pay for printing informational brochures on transportation options for the Back Bay. The developer already has initiated an aggressive transportation management planning process for the existing Prudential Center and is entering into an Agreement with the City of Boston to establish a Commuter Mobility Program on the site. This program is in its early stages of development and the developer is proud that it is among the first developments in the City to participate in this important program. The developer has hired a transportation coordinator, who is responsible for addressing the Prudential Center's transportation plan on a pro-active basis, including identifying and responding to all transportation related issues and concerns. The developer also already has begun to put into action the innovative and extensive Transportation Mitigation Plan described in Volume III of this DPIR. The Transportation Mitigation Plan includes a number of strategies that will have significant benefits to the public.

Public Transportation Improvements

Improve Access to the Prudential and Back Bay Stations

An important element of the overall plan for the redevelopment is to upgrade, to the greatest extent feasible, connections to area public transportation facilities. It has been the developer's goal to provide this type of improved access to the Prudential Station

on the Green Line by physically integrating it into the project site. The hope and expectation of the developer is to increase the use of this presently underutilized station as a means of access to the site by improving the physical condition of the facility and by working with the MBTA to increase train service on this branch of the Green Line. The physical improvements to the station will include the extension of access from the mezzanine level and the outbound platform level via corridors to be located in the existing garage levels of the Prudential Center into the project site and the construction of modern vertical transportation elements, including handicap access. The present intent is to create a new public entry/exit point within the footprint of the development at the first retail level. This improvement will benefit commuters, shoppers and area residents, making it possible to directly enter the project site without being subjected to inclement weather.

Similarly, another major goal of the project is to improve pedestrian connections to the Back Bay Station. This will be accomplished through a better design solution to this linkage than exists today, as described in Volume II, Urban Design Alternatives. For Convention Center oriented pedestrians, a more direct route from the Sheraton Hotel/Hynes Convention Center entrances to the Copley Place pedestrian footbridge at Huntington Avenue will be provided. A more comfortable, climate controlled, and attractive pedestrian environment will be created along this entire route which provides improved connections to the Back Bay Station. This pedestrian route will be identified through signage.

Enhance Access to the Auditorium Station

The developer has committed to upgrading the identification of the Prudential Center with the Auditorium Station Green Line. The station is serviced by the three Green Line branches that carry the highest volume of passengers. The present intent is to improve the identification of the existing pedestrian route between the Prudential Center and

this station by means of signing and pavement upgrading. The developer is also working with the MBTA in the hope of reopening the existing Boylston Street exit from this station and perhaps, upgrading this location to also accommodate an entrance from the street.

Evaluate Expansion of Motor Carrier Service to Logan Airport

Currently, there is motor carrier service from the Prudential Center to Logan Airport provided by Airways Transportation, primarily accommodating patrons of the Sheraton Hotel. The developer is committed to evaluating this existing service and identifying ways to supplement it to serve other parts of the Center. Because there are a wide range of issues that would need to be addressed and all such services are licensed by the Department of Public Utilities (DPU), it is expected that the Final Impact Report will provide further details on this matter. The developer will work with the DPU, MASSPORT, BTD and private carriers to determine the most effective service.

Parking Management

The developer's intent is to provide adequate parking for those who must drive to the site, while at the same time providing incentives for those who can rideshare or use public transportation.

Create Additional Parking Supply

The developer intends to work with the Massachusetts Convention Center Authority (MCCA) to assist in providing additional off-site parking for the Hynes Auditorium. A major opportunity for providing additional parking spaces is for the MCCA to build a new off-site parking facility. The key reason for building a new or expanded facility off-site is to accommodate the parking needs generated by the Hynes Convention Center which currently use the Prudential Center Garage when a major event occurs. On the

heaviest use days, the garage fills and is frequently closed to public parkers; many potential parkers are turned away through the use of security personnel. To accommodate the parking demand created by the Hynes and the new development, two main options exist. Both have been discussed in the Hynes Auditorium Draft EIR, Volume I, August 15, 1984, EOEA #5046.

One of the options for additional off-site parking was for the MCCA to obtain a satellite parking lot of approximately 500 spaces to support the Hynes Convention Center. A second option identified in the past was to construct a new parking facility nearby, possibly on the triangular air rights parcel over the Massachusetts Turnpike and railroad adjacent to Dalton Street and the Cheri garage.

Representatives of the developer have recently met with officials of the MCCA and both parties have jointly agreed to work cooperatively to address the Hynes parking shortage. At this point, the MCCA is commissioning a feasibility study to examine these options. It is expected that a more definitive plan will be presented in the Final Project Impact Report.

Overnight Parking for Area Residents

The developer is committed to providing area residents with a community benefit of overnight parking in the Prudential Center garage at discounted rates. While the program has not yet been designed, it may be possible to tie this into the City's residential permit parking program.

Prudential's commitment to area residents is exemplified by a parking program which was implemented from 1978-1982. This program offered residents reduced rates for one

of two options: overnight parking seven days per week, or overnight/all day weekend parking. The program was discontinued due to limited interest and participation despite extensive promotion. Since that time, Prudential has periodically offered reduced rate overnight parking for residents during Back Bay clean-ups, and continues to do so.

Provide Adequate Handicapped Parking

The Prudential garage currently provides 19 designated handicap parking spaces. Additional spaces will be designated throughout the garage, which will be in compliance with the Commonwealth's Architectural Access Board (AAB).

Access/Circulation Design Improvements

These are improvements to the ways in which the Prudential Center interfaces with the surrounding street system.

Simplify Boylston Street Frontage

The new building program will bring project buildings closer to the street and will eliminate the remainder of the North Ring Road and its associated ramps. Thus, this frontage will be greatly simplified and upgraded. Two curb cuts will replace the current condition along the North Ring Road. The garage entrance/exit will be east of Fairfield Street, as requested by PruPAC and area residents to prevent exiting vehicles from leaving the site and travelling along Fairfield Street.

Widen Huntington Avenue Approach to Belvidere/West Newton Streets

The developer has proposed that Huntington Avenue in the westbound direction be widened by adding an additional right turn lane between the Turnpike off-ramp and the intersection of Huntington Avenue with Belvidere and West Newton Streets. This change has been

proposed to accommodate some of the traffic now using South Ring Road. The widening, to be accomplished at the developer's expense, will create more capacity and a longer vehicle storage area for what will be an increase in volume on Huntington Avenue. It will also eliminate the confusing nature of the existing South Ring Road traffic patterns and the difficulties faced by pedestrians crossing in this area. The developer has also proposed widening Belvidere Street near the Huntington Avenue end by one lane.

Provide a Parking Enforcement Security Guard Along East Ring Road

This commitment is viewed as critical to ensuring smooth traffic flow along East Ring Road and will be implemented by the market operator in cooperation with the developer.

Study of New Back Bay Turnpike Ramp Connections

The developer supports further study of the plans to provide an additional eastbound Turnpike on-ramp and a westbound Turnpike off-ramp in the vicinity of Berkeley Street.

Loading Improvements

These improvements are designed to minimize negative impacts from those activities.

Enforcement of Current Delivery Policy

The developer intends to continue its current policy of requiring all deliveries to be made only to designated loading areas on the site.

Restrict Delivery to Off-Peak Hours

While there may be difficulties with the implementation of changes to the current pattern of truck deliveries, the developer is committed to working with the Boston Transportation

Department to better manage and control truck deliveries. The goal is to encourage midday, off-peak hour usage.

Pedestrian Improvements

These improvements will enhance the pedestrian environment and improve connections to the surrounding areas.

Upgrade Pedestrian Connections to Public Transportation

As mentioned previously, to encourage usage of the many public transportation resources in the area, connections to the Orange Line and Commuter Rail at Back Bay Station and area Green Line Stations will be upgraded. Access to these stations will be simplified through the creation of cleaner, safer, better signed and more direct connections.

Improve Covered Pedestrian Walkways On-Site

As described elsewhere, the enclosure of the pedestrian passageways and the creation of an indoor "street" will greatly improve conditions for pedestrians on the site.

Install Additional Pedestrian Warning Signs at Garage Entrances and Exits

New warning signs will be installed for both pedestrians and drivers throughout the garage and at sidewalks over the next two years. In addition to the installation of warning signage, the new openings serving the site's loading and parking areas will be designed to maximize visibility for both drivers and pedestrians.

Reduce Existing Pedestrian/Vehicle Conflicts Through The Elimination of North and South Ring Road

The key benefit of this measure is that it simplifies travel through the area, and particularly benefits pedestrians who will no longer have to contend with the Ring Road/Belvidere Street intersection. Eliminating North Ring Road has major benefits for pedestrians as well, since conflicts with moving vehicles will be greatly reduced.

Develop Project-Wide Pedestrian Signage Program

Improved signage will serve as a public benefit in a number of ways: in directing pedestrians to and from public transportation services; in guiding pedestrians to major attractions on the site; in improving accessibility to the Prudential Center Garage; and in guiding shoppers to the project's retail establishments.

Improve On-Site Pedestrian Lighting

The redesign will include dramatically improved lighting in the public and pedestrian areas.

Improve Handicapped Access On-Site

The redesign also calls for major improvements to on-site circulation. Throughout the site, there is a strong desire to develop a circulation pattern that is relatively barrier free, allowing greater movement by individuals with physical disabilities. Given the many grade changes across the site, the provision of elevators and ramps will provide a significant public benefit in improving barrier free access throughout all interior and exterior spaces.

Widen Painted Pedestrian Crosswalks

There are several locations on and off the project site where an improvement could be gained by painting in wider and more visible crosswalks. Specific locations to be considered

include streets, service and garage entries. Along Boylston Street where service or parking lanes interrupt the pedestrian walkway, the driveway lanes are proposed to ramp up to meet the walkway elevation and will be paved with the same material as the walkway.

Other

Participate in the BTD's Keep Boston Moving Campaign

The developer will contribute approximately $30,000 to assist the City's efforts in the Keep Boston Moving Campaign. The contribution will be used to help prepare commuter mobility maps that will be distributed free of charge to Prudential Center visitors, employees and shoppers. As mentioned previously, these maps will provide information on public transportation options available to travel to and from the site.

Provide Neighborhood Parking During City-Designated Snow Emergencies

The developer will work cooperatively with the Boston Transportation Department (BTD) to implement a snow emergency parking program. Discount overnight parking for neighborhood residents on declared snow emergency days will be part of the plan.

Monitoring Program

The developer is prepared to provide annual management reports to the City on the project's compliance with the stated goals and objectives, as well as the other areas of the access plan. To accomplish this, the developer will annually conduct a survey of employees, visitors, shoppers and residents of the site. These surveys will be used to assist in determining trip generation rates, travel mode splits, vehicle occupancy rates, peak hour travel percentages, trip origins and destinations, and parking data.

5.5 Infrastructure Improvements and Conservation Measures

The developer is prepared to consider a set of improvements to the infrastructure around Prudential Center, the final package to be determined in view of competing priorities for off-site contributions and the scale of development permitted. If Alternative A is allowed, most, if not all, of the following improvements should be possible. A scaled down program would accompany Alternatives B or C.

Boston Water and Sewer Commission Facilities

The existing BWSC systems are in most cases presently adequate to meet the needs of the redeveloped Prudential Center with no adverse impact on the function of existing systems. The developer is committed to the implementation of improvements on the storm drainage and sanitary sewer systems servicing the 101 Huntington Avenue area of the site and is considering implementation of improvements to other systems.

Water Distribution Systems

A variety of water conservation measures are expected to result in an expected savings in water of at least 15% compared to standard systems. The developer is also considering proposals to upgrade the existing BWSC distribution network to allow the Prudential Center and adjacent properties to be fed by the BWSC system from multiple directions. Although the existing water service systems have been determined to be adequate to supply the needs of the redevelopment, several areas have been identified that could be improved. These areas are presently serviced by lines which are dead ended so that if they are disrupted at any time service cannot be maintained. To improve this condition, segments of pipeline would have to be installed which would complete loops within the water supply system which would allow demand points to be serviced from more than a single direction, allowing for a better chance that service would not be interrupted if a line were lost.

These system improvements will provide an important public benefit by enhancing system flow characteristics and increasing both safety and convenience in the event of a water main break. These potentially costly improvements will be considered in terms of the overall level of development permitted on the site and the multiple needs for infrastructure improvements in the project area.

Sanitary Sewer System

The developer is prepared to consider major improvements to the sewer and storm drain systems serving the Prudential Center. In so doing, the developer would exceed the goals of the Massachusetts Water Resources Authority's (MWRA) "2 for 1 I/I (Infiltration/Inflow) Program," which are expected of the developer. In fact, the proposed improvements would result in I/I reduction ratios of approximately 78 to 1 for the average flow rate and approximately 4.5 to 1 for peak flows. To accomplish this goal a number of improvements are planned.

The developer proposes the implementation of a new separate system that will allow the abandonment of the existing inverted siphon system that carries combined sewer flows from a portion of the St. Botolph Street neighborhood and Copley Place beneath the Prudential Center from Huntington Avenue to Boylston Street. The existing facility is presently partially blocked and could potentially cause major service problems in the future if not addressed. The BWSC is presently anticipating the expenditure of significant monies to clean this facility in the immediate future. This expenditure in addition to potential future ongoing expenditures would be avoided with the installation of the proposed system.

Another modification to the existing sanitary sewer system presently being considered by the developer is the installation of a new system to collect discharges from facilities adjacent to Exeter Street between Boylston Street and Huntington Avenue. The existing system in this area is subject to degradation of function due to existing downstream operational characteristics which the proposed system would avoid.

Storm Drainage System

In conjunction with the sanitary sewer system modification described above that would allow the abandonment of the siphon system below the Prudential Center, the developer proposes the construction of a facility to separate dry weather and wet weather flows at Huntington Avenue. This facility would separate storm flows from the existing combined sewer system and divert them through a proposed storm drainage system parallel to the proposed sanitary sewer system.

In addition the developer is considering other system improvements that would divert storm drainage discharges in the Exeter Street area through a new system out of the Copley Square area described above, and the implementation of modifications in the existing collection system in Boylston Street that would allow the abandonment of a maintenance prone inverted syphon that carries flows beneath the Green Line tunnel to Fairfield Street.

In addition to improving the operations of the specific collection systems described above, these system improvements would also improve the operation of the major area-wide interceptors.

Electrical Energy Requirements

The developer has taken major steps to improve the energy efficiency of the existing Prudential Center, resulting in a reduction in electrical energy consumption of 17% since 1973. As a member of the North East Energy Cooperative, the developer moderates loads during peak demand, whenever requested, which has had a decidedly positive impact on Boston Edison efforts to provide power to customers during difficult high peak periods. Demand limiting approaches such as ice storage for air conditioning are also being evaluated. Additionally, all new structures will have emergency generators which can be used to mitigate impacts during system peak demands.

Steam Use and Conservation Practices

Conservation measures over the last fifteen years have contributed to a net reduction in steam use of over 50%. Energy conservation options incorporated into the new development will have an important impact on steam use for space heating. Implementation of the applicable new State Building Code standards which deal with building envelope features to conserve energy, will significantly moderate steam use.